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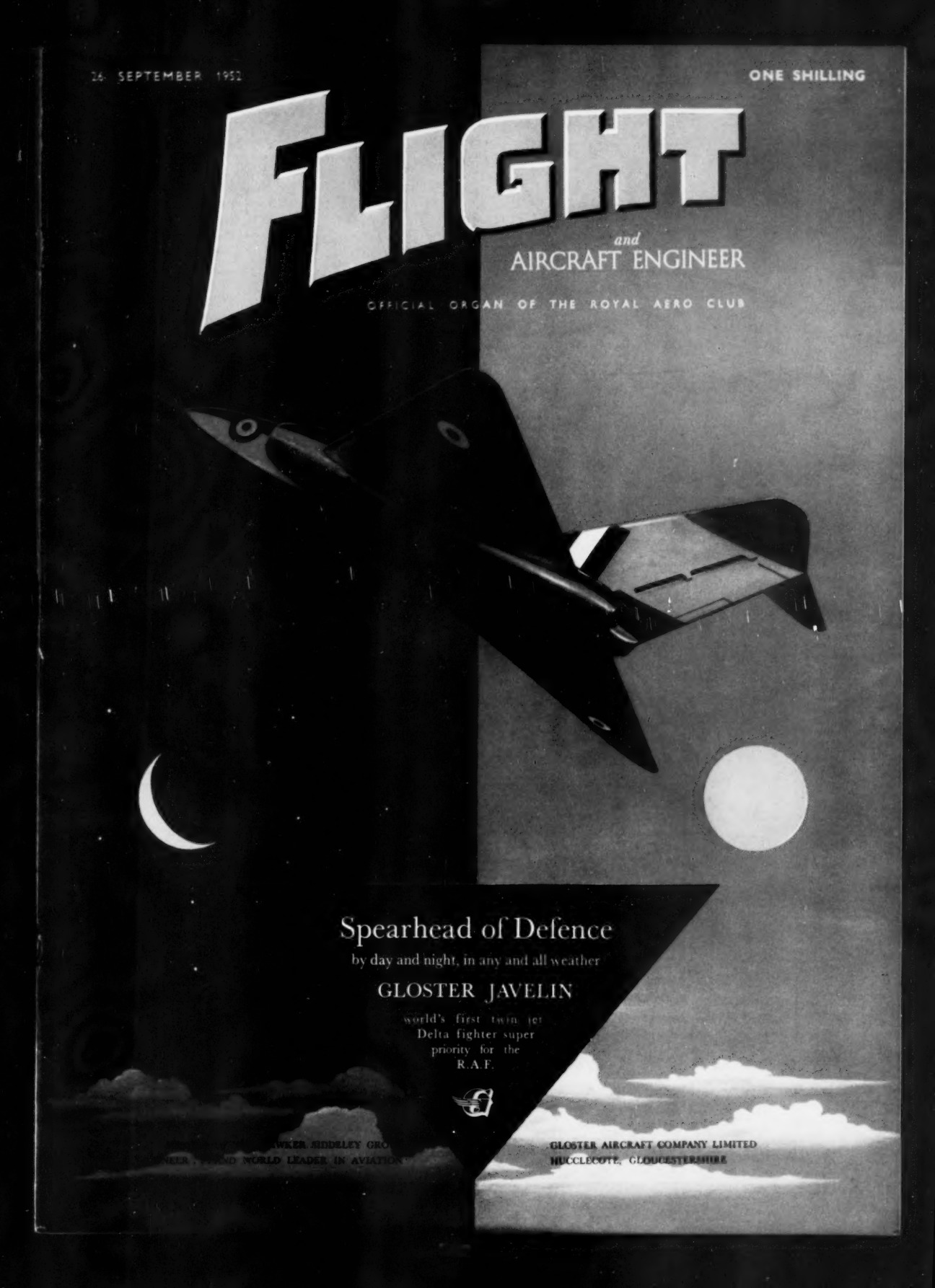

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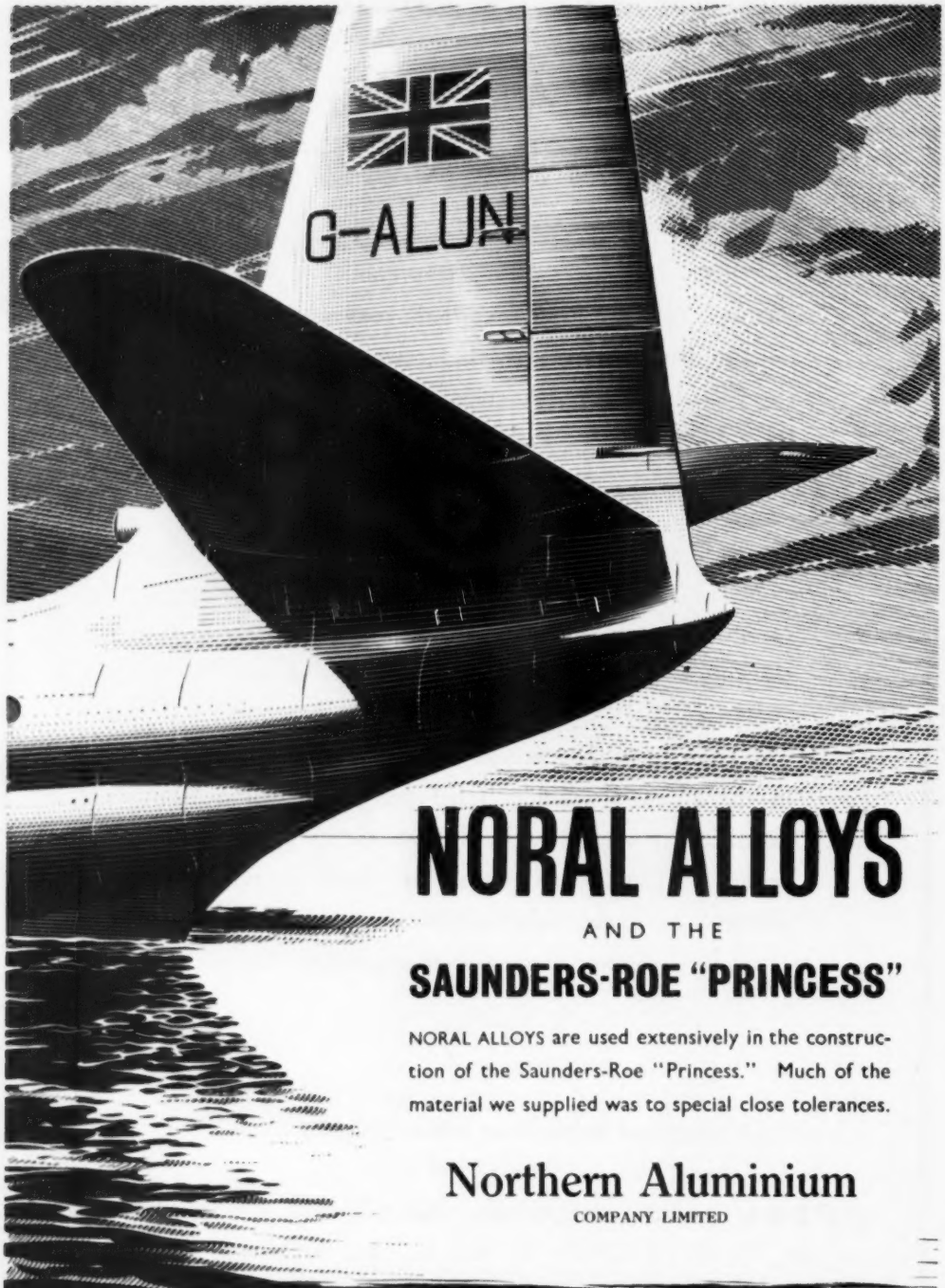

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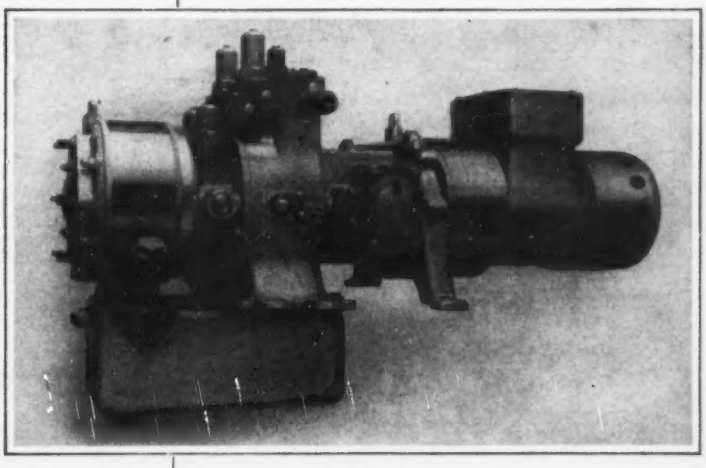

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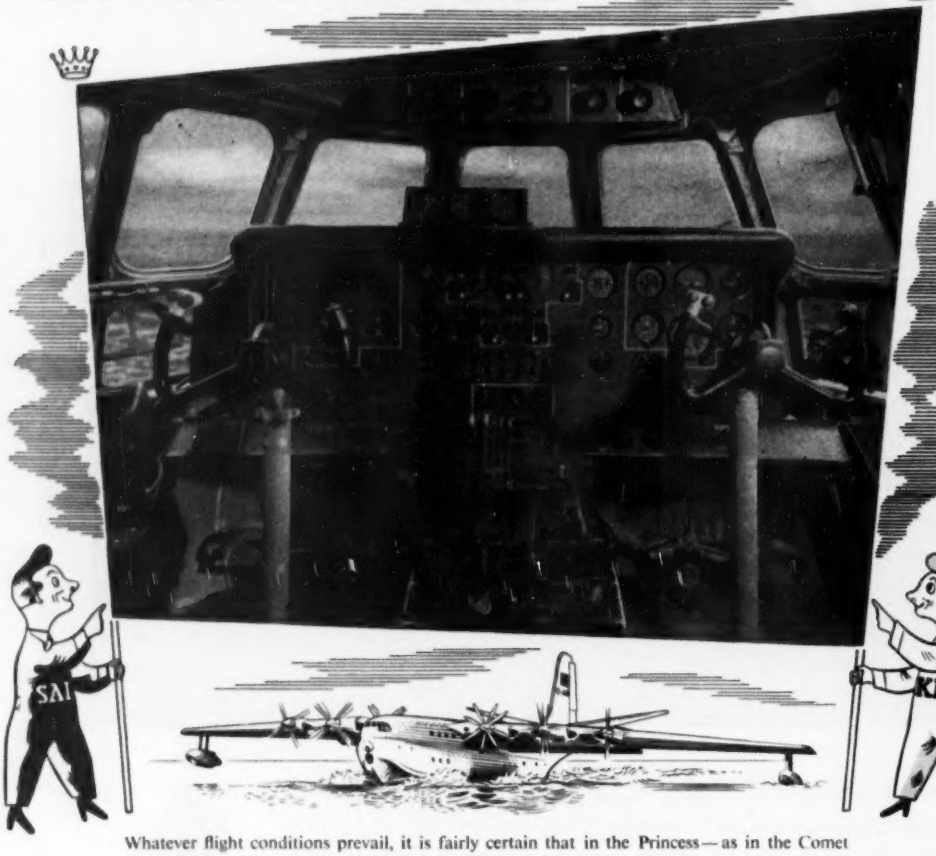

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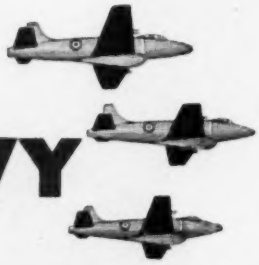

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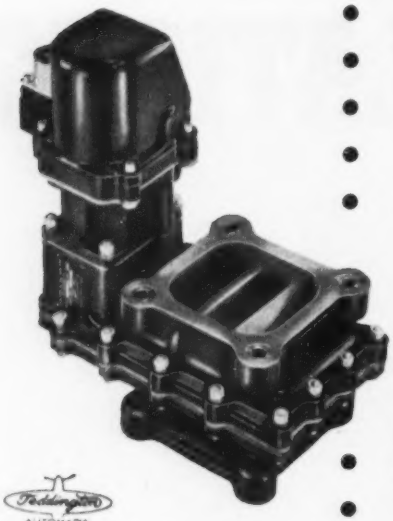

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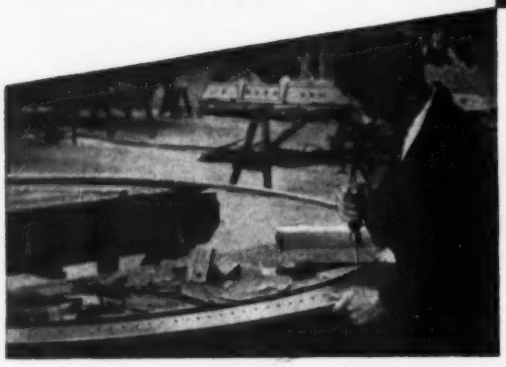

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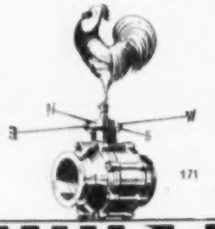

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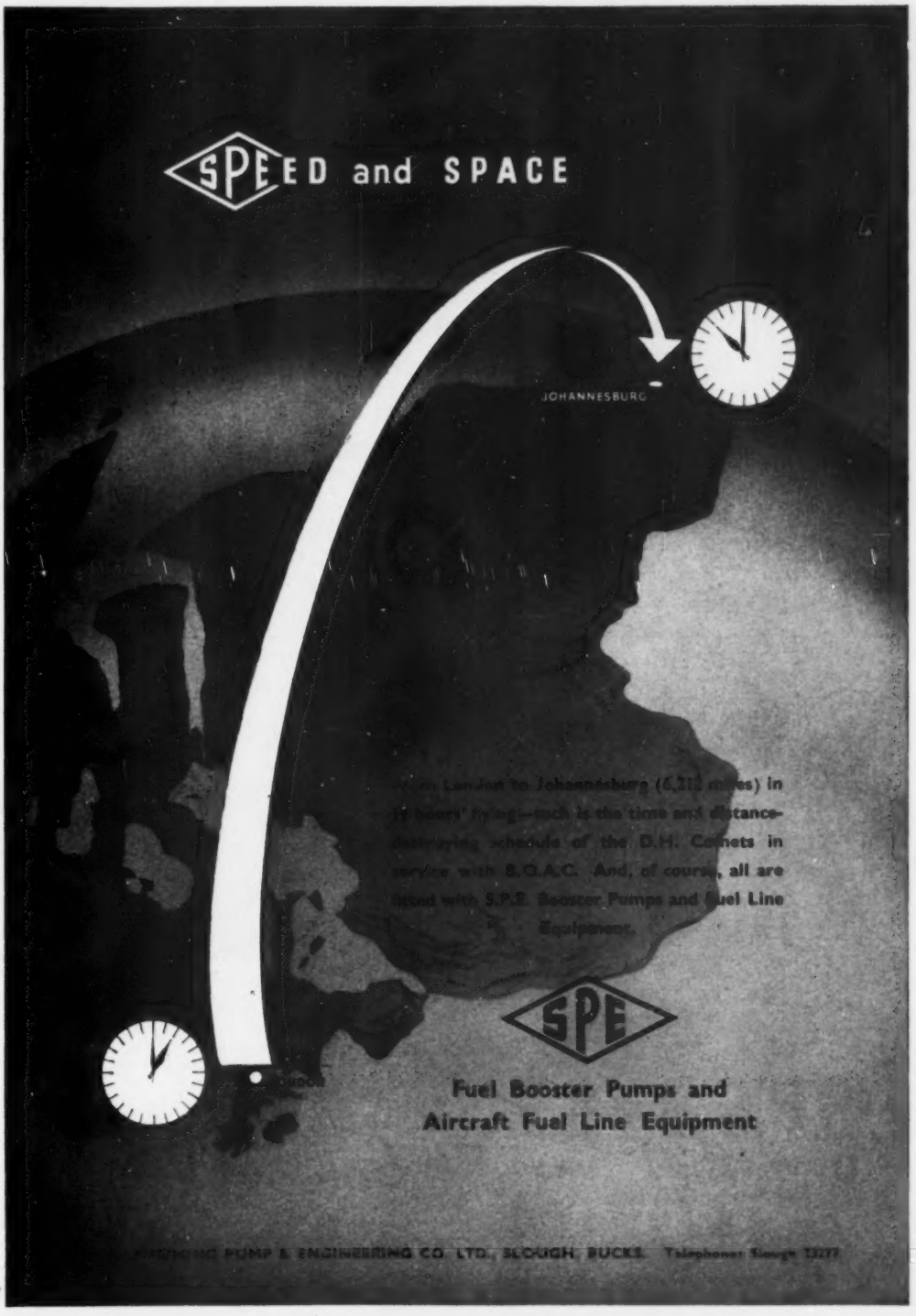
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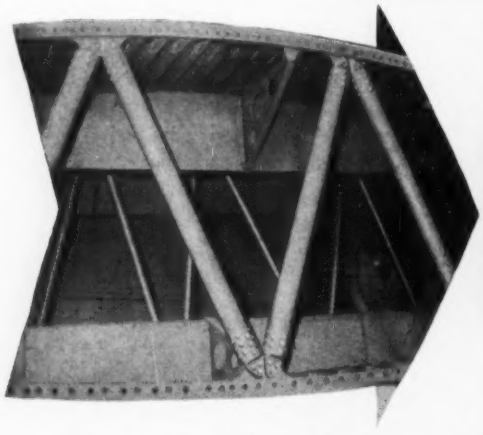

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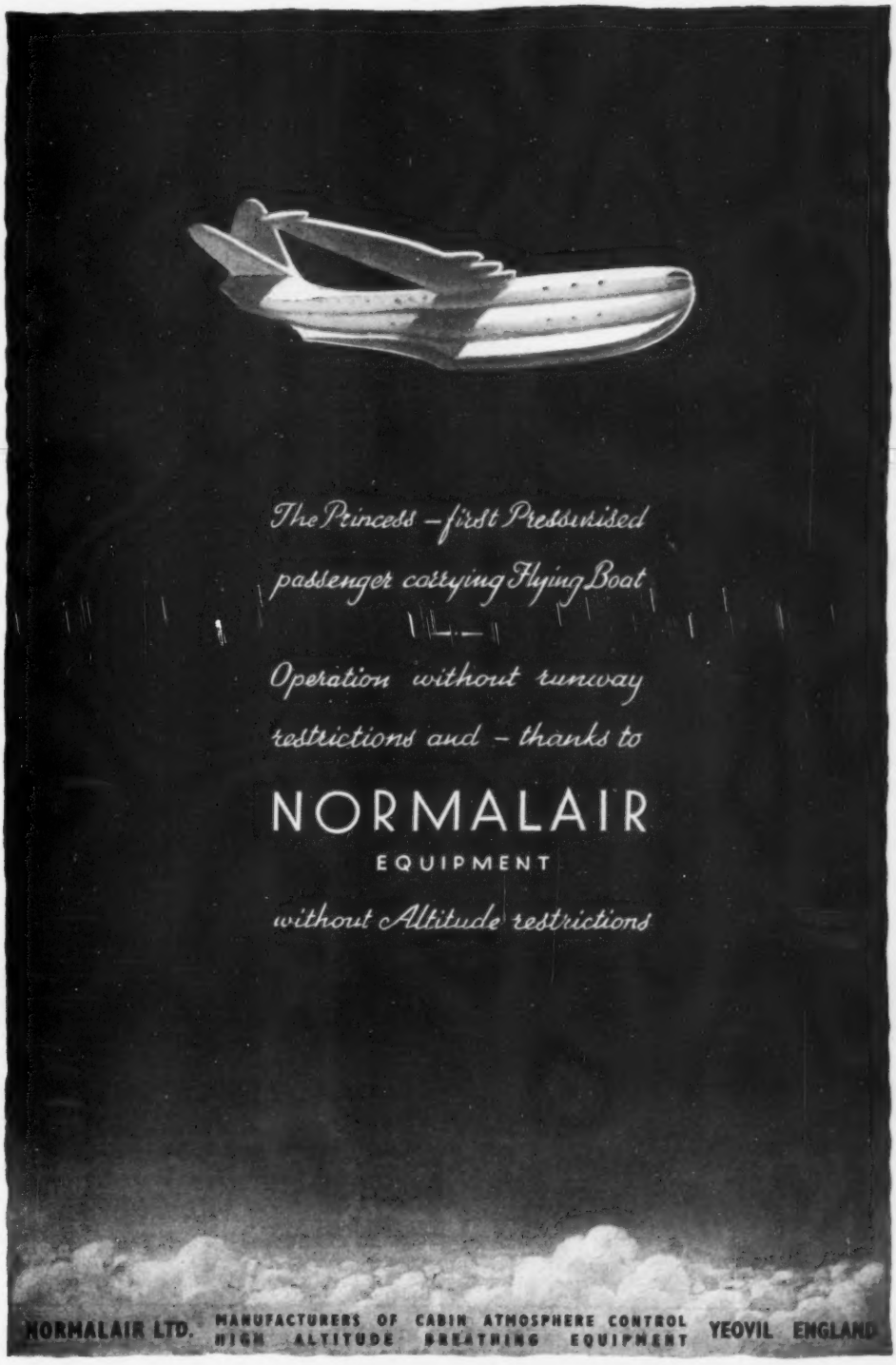
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First Aeronautical Weekly in the World

Founded 1909

No. 2279 Vol. LXII. FRIDAY, 26 SEPTEMBER 1952

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B.O.A.C.'s Profit

A MODEST profit perhaps, but all their own work: that is what Sir Miles Thomas and his B.O.A.C. staff of 16,632 can justly claim. And it has not been easy to show an overall profit on a full year's operations in the face of rising costs, ever-keener competition and the need to keep fares to a minimum—in fact, to reduce them.

An examination of the Corporation's accounts for the twelve-month period ended March 31st indicates that no single department has been responsible for turning a £4½ million loss into a profit of more than £½ million; rather has improved efficiency all round chipped away the deficit. The revenue per employee has risen to over £2,000 per annum as compared with some £550 in 1948; the break-even load factors for B.O.A.C.'s aircraft fleet have come down from an impossible over-capacity figure to a reasonable 65 per cent; operating costs expressed in pence per capacity ton-mile have dropped some 57 pence to 38; and in sheer money earned the Corporation's figures indicate a rise from under £15 million in March, 1948, to substantially over twice that figure this year.

That such a small but important matter as increased air-mail rates can be sufficient to turn a deficit into a profit is indicative of the marginal nature of the figure this year. In respect of the higher mail-rates paid, a sum of £1.3 million is noted; even so, the rate is considerably less than that paid to several other operators for similar services. Again, the loss caused by the American fuel strike—it will be felt in the next annual accounts—involved a sum equal to this year's profit. Sir Miles rightly stated in his conclusions that "the margin of profit was small in relation to the uncertainties of airline transportation." It is encouraging that this year the task achieved was not only one of showing a profit from par, but first of eradicating the causes of previous heavy losses.

The outlook for the current twelve-month period is mixed. Costs are still rising and a single fuel strike, or similar industrial upset, invariably brings heavy loss. Changes in world trade conditions, restrictive practices by individual countries, another change in international air-mail rates—all or any of these things might profoundly affect results. However, B.O.A.C. is better equipped, in the broad sense, to deal with such contingencies than ever before. Staff morale is reported to be high, while the Corporation's international reputation has been so enhanced month by month that it is the envy of all competitors.

Thoughts From Geneva

AS a shareholder, the British reader will follow with keen interest the encouraging progress of B.O.A.C. We would also commend to his attention, whether or not he is versed in the politics of international airline operations, the proceedings at last week's annual meeting of I.A.T.A., as reported on page 424 of this issue. The future of the entire airline industry and the degree of service it can give the public are dependent upon the decisions reached in international discussion by the member-companies of I.A.T.A., who between them carry the bulk of the world's air traffic. This is a healthy and powerful organization, which has in the past few years made immense strides. In the words of its British director-general, Sir William Hildred: ". . . we have promoted trade, cut to the bone the barriers of distance, united families and turned the last war's most devastating sword into the greatest ploughshare in history."

Few large international organizations have attained the unanimity of purpose exemplified in the I.A.T.A. proceedings at Geneva last week; there one sensed the importance of the part which air transport can play in uniting the nations. Some sixty of the world's airlines were represented at this one gathering by one or more of their top executives. The British observer was particularly impressed by the contributions which his fellow-countrymen, both airline executives and others, have made to the success of I.A.T.A.

Naturally enough, informal discussion between delegates often centred on the question of re-equipment, reminding us once again of the opportunities awaiting British manufacturers. The U.S. operators and manufacturers were not slow to realize the opening for discreet salesmanship; models of American airliners in the colours of various companies were displayed in the Geneva shop-windows and hotels, serving to keep the undoubtedly excellent qualities of these aircraft in the forefront of conversation. Unfortunately, none of our companies showed the same business acumen. British prestige is running high, but such opportunities, however small, should not be missed.

"Flight" Photograph

D.H. Venom F.B.1s, operating from Wunstorf under the command of S/L. D. H. Seaton, D.F.C. They were mainly active in the intercepter role.

THE NATO EXERCISES

Part I: The Overall Picture: Mainbrace

PUZZLED as to the nature and scope of the numerous exercises recently mounted in Europe (and we were certainly not alone in our search for knowledge), we determined to seek guidance at SHAPE. There, in the pleasant new buildings at Versailles, with their sound-proofed walls, the picture was drawn for us.

It had been the intention of General Eisenhower that, following the successful combined exercises of last autumn, one vast co-ordinated effort should be made this year, whereby the top staffs would be thoroughly exercised and tested; but when General Ridgway assumed command he re-examined the matter and, jointly with Marshal Juin, the C-in-C. Allied Land Forces Central Europe, formed the opinion that, although this year's manœuvres should be large in scale, they should once again be of a localized character. Thus, they would primarily concern the relatively junior staffs. It may be supposed, moreover, that due consideration was given to the possibility of a Russian attack in Europe, in which event the various Allied forces, operating in their allotted areas, would not find themselves placed too disadvantageously.

Next year General Eisenhower's proposal for a vast unified exercise may be realized; meanwhile, General Ridgway and Marshal Juin are losing no opportunity of visiting their forces and of observing and advising on the endless succession of exercises, of which those immediately concerning us are but a few. In two months, one learned, the general has been with his soldiers or airmen in the field nearly every day, his travels having taken him over most of the 6,000-mile Allied front, from Northern Europe down to Turkey.

Most northerly of the recent inter-related exercises, and most publicized by the daily Press, Mainbrace (which is the subject of a separate account on the opposite page) was largely a naval affair, engaging British, American, Canadian and Danish naval forces, the air forces of Great Britain, America, Denmark and Norway, and a very large proportion of SACLANT (Supreme Allied Command Atlantic). In the Southern Sector, Exercise Ancient Wall, directed by Admiral R. B. Carney, U.S. Navy (C-in-C. Allied Forces Southern Europe), was the largest undertaken by the southern NATO forces and itself comprised a series of manœuvres designed for the comprehensive training of small units. From his mobile H.Q. Lt. Gen. Frattini controlled seven different manœuvre areas in N.E. Italy. The air side was wholly international and was the responsibility of Maj. Gen. D. M. Schlatter (Commander of Allied Air Forces Southern Europe). Operating in conjunction with the ground forces was Maj. Gen. Cupini's 56th Tactical Air Force (Italian), carrier-borne and land-based aircraft from Vice-Admiral Cassady's U.S. 6th Fleet, fighter/bombers and transports from the Central Sector, and an air unit of the 1st Territorial Air Zone (Z.A.T.).

Equinox was a Franco-American army exercise, under French command, and engaged French and American tactical aircraft and a French airborne unit; Hold Fast, in Germany, was a joint B.A.O.R./2nd A.T.A.F. affair, with Belgian, Canadian and Dutch forces participating; and Rosebush (7th Army) had for its theme that most difficult of land operations, a defensive withdrawal.

On September 16th, over the Hold Fast and Equinox areas, there opened a full-scale air phase called Blue Alliance, in which the whole of General Lauris Norstad's Allied Air Forces Central Europe were involved. Directed by the general himself, Blue Alliance had, of course, an aggressive and a defensive side, the former under the direction of A.V-M. C. R. Slemon, R.C.A.F., who had come over from Canada specially to undertake the task. Available forces were equally divided between the two sides and the aggressors were to saturate or break down the air defences, thereby permitting an assessment to be made of their ability to cope with a really heavy air attack.

Blue Alliance was planned as another step toward the realization of SHAPE's three original directives to AAFCE: (1) to gain and maintain air superiority over Central Europe and approaches thereto; (2) to render full and continuous support to Allied Land Forces; (3) to take from national strengths allocated by SHAPE and constitute a single integrated force.

The exercise was the first "unphased" example of its kind and from September 16th it ran for 24 hours daily for six consecutive days and nights. It was also the first of the NATO manœuvres to have Portuguese Air Force participation (a small Portuguese component took the field) and it was the 44th air exercise in which AAFCE elements had participated since the beginning of this summer. Realism was added by permitting the aggressors to employ limited sabotage and espionage as manœuvre weapons and

Studies in camouflage, adventitious and deliberate: (left) "shadow shading" on Air Marshal Sir Robert Foster, C-in-C., 2nd Allied Tactical Air Force; (right) netted Vampire F.B.5s standing at their dispersal-points at Wunstorf. "Flight" Photographs

parachute troops were available for use on the northern and southern exercise fronts. Control and reporting training between the United Kingdom and Central Europe was continuous. To link the overall defences of Central and Southern Europe, at certain stages of the exercise jet aircraft from Central Europe went ranging into Italy and the Mediterranean to participate in Ancient Wall, while to provide practice in the redeployment of aircraft to new bases on short notice some squadrons were moved from the United Kingdom to the Rhineland.

That, then, is the broad pattern of the exercises—vast in scope and scale, and of deep significance to everyone in Western Europe. Next year, as we have intimated, the time may be deemed ripe for one all-embracing manœuvre, exercising all levels of command, and if this should come about even greater forces would by then be available. Meanwhile all arms will be active—in the winter as well as in the spring and summer (for the most acute operational problems present themselves in the cold and murky weather)—in perfecting new techniques and working up to a yet higher pitch of efficiency and readiness.

While we were at SHAPE (where General Ridgway's Air Deputy is Air Chief Marshal Sir Hugh Saunders) we were reminded that General Eisenhower reported last April that, as then scheduled, NATO's European air arm would include by the end of this year some 4,000 operational aircraft, a significant proportion of which would be modern jet fighters. This number, however, would still be far from meeting the ultimate requirements; moreover, the operating value of the force would largely depend on progress made in developing the aircraft warning system and in the supply and maintenance organizations.

The airfield problem is still a very real one, but under the "infrastructure" programme (which term embraces such permanent installations as aerodromes, ports, dumps, etc.) tangible progress is to be seen. It must be understood that the new airfields are paid for by the fourteen NATO countries and not by a single wealthy State, as is the case with American air bases in various parts of the world, so that financial difficulties are among the most formidable; but there is also that of obtaining sites. In France, for example, the country is largely agricultural land or mountains, so that when a suitably flat airfield site is found (and this, we were assured, is a matter of the utmost difficulty) the claims of the farmers are loudly advanced in opposition.

It is well to have such factors in mind when considering the Continental exercises.

We ourselves concentrated our attentions on Hold Fast and Mainbrace. Our impressions of the former exercise—in which we were abundantly rewarded for our pains—must be held over till our next issue, but some notes on Mainbrace now follow.

Exercise Mainbrace

The initial assumption in Exercise Mainbrace was that Orange ("enemy") forces, with strong submarine and air support, had invaded Norway from the north, and in addition were attacking Denmark from the south, with possible amphibious attacks on Jutland. To bring immediate help to the Allied (Blue) forces in Norway, who were defending a line just north of Bodo, some 60 miles north of the Arctic Circle. The first step in the exercise was the movement of an Allied carrier task force, preceded by a "hunter-killer" group, from the U.K. to the scene of action.

Other phases of the exercise were :—

(2) In the Kattegat and the Baltic approaches to Denmark, light naval forces from Denmark, Norway and the U.K. were to exercise, under Danish command, with submarines and coast defence units, to protect the Danish coast.

(3) Convoys to and from Scandinavia were to be protected by surface forces and carrier- and shore-based air forces.

(4) After the situation in Norway was stabilized, the main carrier force was to move south, refuelling *en route*, to support amphibious landings in Jutland.

(5) An amphibious force, including U.S. Marines, was to sail from the U.K. and aid the land forces in Jutland.

The first phase was successfully carried out during the first days of the exercise, in spite of submarine and air attacks from Orange forces. Carrier-borne and land-based aircraft flew protective patrols in support of the Blue convoys, and located and attacked several Orange submarines. The joint operations centre at Bodo functioned well, although the communications between naval aircraft and their ground control teams were not always good, and operations were later restricted by bad weather.

"Flight" Photograph

One of the Boulton Paul Balliol T.2s operated by the composite night ground attack force at Fassburg, under the command of W/C. F. D. Hughes, D.S.O., D.F.C.

By the end of the first week, the second phase had been completed; the third was continuing; and the fourth had begun, as the task force turned south towards Denmark. Bomber Command were to use Washingtons and Canberras in their attacks on the Blue forces. With the amphibious landings in Jutland, and the Army exercise, Scandia III, farther south, the operation was concluding.

In all phases, the importance of both carrier-borne and land-based aircraft in support of naval movements has been shown, as has the importance of effective air-sea and air-ground communications, and Admiral McCormick himself has spoken of the need for more carriers. Following the completion of Exercise Mainbrace, a critique will be held on board H.M.S. *Eagle* in Oslo harbour on September 27th, when a full appraisal of the effect of the flying operations will be possible.

To carry mail and supplies to remote Coastal Command units involved in Mainbrace, a Dakota of No. 18 Group Communications Flight made regular duty-flights from Leuchars throughout the exercise, visiting squadrons in Northern Scotland, the Shetlands and Norway.

A *Flight* representative who flew on one of these trips writes that at Leuchars the presence of Orange aircraft (they were Netherlands Navy Harpoons and Royal Navy Hornets) on the airfield was tactfully ignored as the Blue duty aircraft prepared to take off.

The first leg of our flight (he continues) was to Kinloss, Morayshire, where were based the Shackletons of 42 and 220 Squadrons, whose rôle in the exercise was to maintain continuous anti-submarine patrols in support of the Allied convoys heading towards

A salty scene in Mainbrace : Fairey Fireflies ranged aboard H.M.S. Illustrious. Astern are the U.S. carrier Wright, H.M.S. Vanguard, and H.M.S. Crossbow.

(Top) PV-2 Harpoons of the Netherlands Navy, based at Leuchars, located Allied surface vessels for the Orange forces in Exercise Mainbrace. (Bottom) Engaged on long-range reconnaissance patrols for the Allied fleet, Coastal Command Shackletons line up at Sola airfield, Stavanger.

THE NATO EXERCISES . . .

Norway, though their searches had so far yielded no sight of enemy craft. Before leaving Kinloss, also, a glimpse was obtained of an early warning Neptune. The next call should have been at Scatsta, Shetlands, but as a gale had been reported there we flew direct to Trondheim, Norway. The weather on this leg was extremely cold and, flying above cloud most of the time, we saw little sign of major naval movements below.

From Skogn flying-boat base, near Trondheim, 14 U.S. Navy Mariners and four Coastal Command Sunderlands (of 230 Squadron) were operating; they had been engaged in a special search for the Orange surface raider *Quebec*. After a short refuelling stop at Trondheim, we flew on to Gardermoen airport, Oslo, where U.S. Navy Constellations and B-17s, their operations and equipment shrouded in secrecy, were based.

A night stop was made here, and the following morning we continued to the Sola airfield, Stavanger, where Shackletons of 120 and 240 squadrons, and Norwegian Air-Sea Rescue Catalinas were engaged in supporting the Blue fleet. During a visit to the Operations Room, we heard from S/L. A. Griffiths, Senior Intelligence Officer, of the 12-hour patrols which had been made ahead of the main Blue forces approaching Bergen; 26 sorties had been flown during the first five days of the exercise. Co-operation with the other Allied forces was excellent, and, due to initial Norwegian optimism on the strength of the airfield's grass surface, one Shackleton, at least, had made a deep impression on Norway.

The next stop was at the bleak Shetlands airstrip of Scatsta, near the flying-boat base (specially re-opened for the exercise) at Sullom Voe. Here four Sunderlands of 201 Sqn. were engaged also on the monotonous but vital patrol work, together with four U.S. Navy Mariners.

And so back to Leuchars, and to the two Orange squadrons there. The Sea Hornets of 809 Squadron had carried out notably successful low-level attacks on the Allied carrier task-force, and had brought back full and accurate information concerning the ships' dispositions. The Netherlands Harpoons of 320 Sqn. too, had been active, locating and tracking the Allied convoys; Lt. Cdr. W. de Groot, the squadron commander, who had flown with the same squadron in Hudsons from Leuchars during the war, expressed satisfaction with the Harpoons, except that they were not very roomy ("especially if the navigator is a fat man"). The extra tanks, specially fitted for the exercise, permitted eight-hour patrols to be made, and the only set-back in the operations had occurred that day, when a carrier-based fighter claimed to have shot down one of the Harpoons. Working together with different nationalities, said Lt. Cdr. de Groot, had caused no difficulties.

Although it is early to say what the lessons to be learned from Mainbrace are, the necessity for complete understanding between the N.A.T.O. countries in such operations is obvious. It was heartening to learn that the co-operation between units of different nationalities was proving successful, at least at the level of the operating squadrons.

FROM ALL QUARTERS

Friendship and Freightship

FIRST mention was made last week of the Fokker project for a DC-3 replacement. More details of the aircraft, which bears the designation F.27 Friendship, have been released since the first note appeared. The intention is to build two prototypes—one powered by two Rolls-Royce Dart turboprops, the other by two Wright Cyclone piston engines. Provisional figures have been released for the turboprop-powered version, which will have a span of 95ft, length of 65.5ft and wing area of 754 sq ft. Gross weight would be 39,550 lb, of which payload would amount to 5,850 lb—equivalent to 28 passengers, luggage and freight. Speeds at 20,000 are quoted as 274 m.p.h. (maximum) and 246 m.p.h. (economical cruising). Under I.C.A.O. conditions, take-off and landing distances over a 50ft obstacle would be, respectively, 4,200ft and 3,770ft. A block speed of 208 m.p.h. is quoted.

Sir Cuthbert Quilter

FROM the G.Q. Parachute Co., Ltd., Woking, we learn with regret of the death of one of their directors, Sir Cuthbert Quilter, Bt.

Sir Cuthbert was the father of the company's chairman, Mr. J. R. Quilter, who took up flying in 1927 and, becoming interested in the technique of parachuting, carried out some of the earliest delayed drops. He now succeeds to the baronetcy, and will be known as Sir Raymond Quilter.

The Ice-Cap Rescue

ONE of the two Transport Command Hastings dropping supplies to the British North Greenland Expedition made a forced landing on the ice-cap on Tuesday, September 16th, and, as we go to press, the crew of 12 is still awaiting rescue. None was seriously injured. The Hastings carried sufficient fuel and supplies to last ten days and the fuselage was sufficiently intact to give the men protection from the sub-zero temperatures.

Methods of rescue examined at a conference at Transport Command headquarters included the alternatives of using an aircraft on skis, flying long-range helicopters from Thule (the American arctic base some 500 miles away), sending tracked "Weasel" vehicles overland, and making the 300 miles journey by dog sledge from the expedition's main base at Britannia Lake.

On September 24th a Grumman Albatross amphibian fitted with hull and tip-float skis, together with other aircraft of the American 6th Air Rescue Squadron, were waiting at Thule to attempt a rescue. Rockets will be fitted to facilitate take off from the 8,000ft high ice-cap.

Meanwhile the second Hastings at Thule is continuing the

DEVASTATING DRONE: The impact of a pilotless, television-equipped Grumman Hellcat, carrying a 2,000 lb bomb, is seen on a North Korean railway tunnel. Launched from the U.S.S. "Boxer," the Hellcat was directed from a Douglas Skyraider (in foreground) which took over control when the drone reached a height of 500ft.

MEXICAN APPROVAL: Mr. Winston Guest, president of Mexico's Aerovias Guest airline, with his chief engineer, Mr. George Montero (right), inspect the Bristol Britannia prototype at Filton. In spite of the political and other problems which face purchasers of new airline equipment in their quarter of the globe, negotiations with the Britannia's constructors are said to be "far advanced."

SEA-BOOTED: Equipped with floats and small wheels, this Westland-Sikorsky S-51 helicopter has been ordered by a Norwegian whaling company for spotting-duties. Mr. R. S. Bradley was in charge of the recent A.R.B. floating, taxying and alighting tests, which were successfully completed at Calshot. This is the first Westland-Sikorsky to be fitted with amphibious gear.

original task of dropping supplies to the expedition, and a third Hastings, which has been modified for low-temperature flying, was due to leave for Greenland on Tuesday last.

Russians Over Alaska?

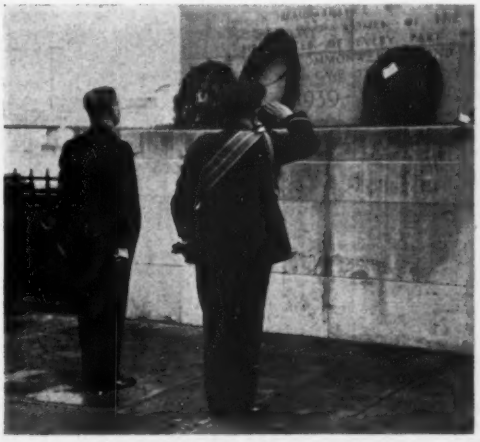
LAST week's reports—and earlier ones—of vapour trails over the coast of Alaska opposite Siberia are thought to indicate that Soviet aircraft are reconnoitring this strategically important coastline. The United States military and air authorities are taking every precaution against what was described to a correspondent recently returned from Alaska as "the possibility of a Pearl Harbour up here in the Northlands," even to the extent of enrolling Eskimos as spotters for the Alaska National Guard. At settlements like Kotzebue, on the coast just across the frozen sea from Siberia, the sharp-eyed Eskimos are being given instruction in aircraft recognition.

Our correspondent writes that during the several occasions on which he drove along the Alaska Highway past Eilson Airfield, some 30 miles outside Fairbanks, the perimeter defences were manned by units in full battle equipment, including tin hats, and the anti-aircraft guns had their muzzle-covers removed and were fully manned. Fighters were at readiness.

In Fairbanks itself he was told that 24-hour "full alerts" were frequent, but that they should not yet be interpreted as reflecting anything beyond the American desire to keep the Alaska garrisons on their toes. It was suggested that, by some sort of unofficial agreement, the Americans were not flying over Siberia and that the Russians were not flying over Alaska. (The two territories are by no means remote; they are separated only by the 40-mile-wide Bering Straits, and in the channel lie two islands—America's Little Diomede and Russia's Big Diomede—only four miles apart.)

COMMONWEALTH TRIBUTES: Sir Thomas White, High Commissioner for Australia and Air Chief Marshal Sir Leslie Hollinghurst, Air Council Member for Personnel, laid wreaths on the R.A.F. Memorial before attending the Thanksgiving Service in Westminster Abbey.

"Flight" photograph



Brigadier-General A. C. Lewin

WE regret to hear of the death, in Nairobi last week, of Brigadier-General A. C. Lewin, C.B., C.M.G., D.S.O., at the age of 78. Known as the "flying general," he took up private flying on retirement from a distinguished military career. He was runner-up in the 1937 King's Cup Air Race, and as recently as this year he won the East African Aerial Derby.

Brig-Gen. Lewin

Born in July 1874, Arthur Corrie Lewin was educated at Cheltenham and Trinity Hall, Cambridge. He entered the King's Regiment in 1895, served with the Mounted Infantry in South Africa from 1899 to 1902, and joined the 19th Hussars in 1905. He served throughout the 1914-18 war, and was A.D.C. to H.M. The King from 1918 to 1941. In 1931 he learned to fly, at the age of 57, and in the same year flew solo from Britain to Kenya, after only 50 hours' solo. Since then he had owned ten personal aircraft and had flown over 2,500 hours as a private pilot. He flew between Kenya and Britain several times; on one such flight, in 1937, he and his wife were marooned for ten days in a Sudan swamp where his aircraft had force-landed; they were rescued by Dinka tribesmen. In the same year he came second in the King's Cup Air Race, and was also appointed an honorary air commodore, R.A.F.V.R.

During the Second World War he flew as Sub-Area Commander and later as Welfare Officer with the R.A.F. East African Command. On March 2nd of this year, flying a Tiger Moth, General Lewin won the Aerial Derby, main event in the Aero Club of East Africa's Air Rally, and was presented with the East African Standard Cup. A recent and well-deserved award, that of the Royal Aero Club's Bronze Medal, was made in recognition of the General's "outstanding record of private flying."

Safer U.S.A.F. Flying

THE accident rates of the U.S.A.F. continued to decline in the first six months of 1952, despite a considerable increase in flying hours. The figures per 100,000 hours flown, for various types of military aircraft, were :—

	July-Dec. 1951	Jan.-June 1952
Jet fighters	97	79
Other fighters	75	66
Trainers	26	23
Bombers	19	18
Transport aircraft	11	10

The average rate for major accidents, which reached its peak in 1946 at 61 per 100,000 hours flown, dropped to 32 in the last half of 1951 and to 21 in the first half of 1952. Corresponding R.A.F. figures have not been disclosed, on security grounds.

HERE AND THERE

LONGER LINCOLN: A fortnight ago we reported that R.A.A.F. Lincolns were being modified to take anti-submarine radar. This is how the modification appears, with the familiar nose lengthened by 6ft to accommodate the search equipment and its operators. Handling qualities are said to remain unimpaired. The photograph was taken at the Government Aircraft Factory at Fisherman's Bend, Melbourne, where the conversions are being made.

Carrier on Loan

THE 13,000-ton aircraft carrier H.M.S. *Vengeance* is now on her way to Sydney, where she will be on loan to the Royal Australian Navy until a new carrier, now under construction there, is completed.

German Air Display

AN international air display is to be held by the Nordrhein-Westfalischer Luftsportverband at Dortmund on October 5th, with the co-operation of R.A.F. units serving in Germany. British pilots wishing to attend are asked to notify the Royal Aero Club Aviation Centre (Touring Section).

Model Victory

A BRITISH-BUILT model aircraft won the international 2.5 c.c. power-model contest, recently held at Zurich, in which modellers of nine nations competed. Owned by Barry Wheeler, of Birmingham, it was flown by proxy by a Swiss competitor. A Swiss model was second and an Italian third.

Give us the Tools . . .

OPENING the Machine Tool Exhibition at Olympia last week, Mr. Duncan Sandys, Minister of Supply, expressed his appreciation of the contribution to British military-aircraft and other defence production made by foreign—particularly American—machine-tool manufacturers. To date, he said, we had received about half the tools ordered from abroad. "I hope our guests from overseas," he added, "will not think me impolite if I say that we would like the other half—as quickly as possible." The exhibition remains open (9.30 a.m. to 6 p.m., Sunday excepted) until October 4th.

No Prize for Identification

MANY young people had their first sight of an airship when the 46,000 cu ft *Bournemouth*, G-AMJH, flew over Bedford on September 18th during a 1 hr 40 min circuit from Cardington, with Capt. Beckford Ball in command of a crew of four. She had previously been airborne on September 8th for the first time since her initial trials in August of last year.

S.L.A.E. Lecture

THE first 1952-53 main lecture of the Society of Licensed Aircraft Engineers will be given at the Institute of Education, Southampton University, Hants, at 3 p.m. tomorrow, September 27th. Maj. P. L. Teed, F.R.Ae.S., A.R.S.M., M.Inst.M., M.I.M.M. (Vickers-Armstrong's Aircraft deputy chief of aeronautical research and development), will present a paper entitled "Fatigue—What It is and Some Ways of Reducing its Incidence."

Rotor-borne Troops

OVER 2,000 soldiers took part in a helicopter exercise held at Fort Bragg, North Carolina, last week. Mr. Karl R. Bendetsen, Under-Secretary of the U.S. Army, said that plans had been made for the forming of a highly mobile force of 20 "helicopter companies." A few days earlier, Mr. Frank Pace, Secretary of the Army, had been greatly impressed by a demonstration of one of the series of tiny single-seat, jet-rotor machines developed by the American Helicopter Co.

Scope for the Universal

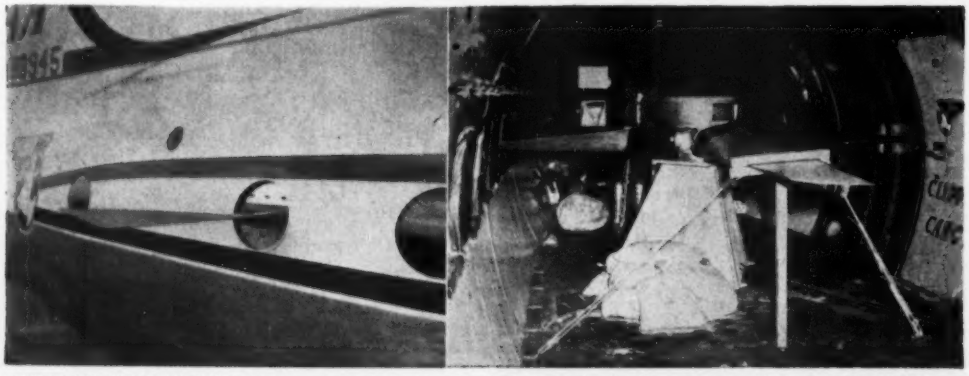
NOW in Canada, making an extensive tour to examine marketing possibilities for the Universal Freighter, is A.V-M. H. N. Thornton, sales director of Blackburn and General Aircraft, Ltd. He believes this capacious aircraft to have unique scope for moving heavy plant and vehicles about the remote areas of the North.

Potent Weapon?

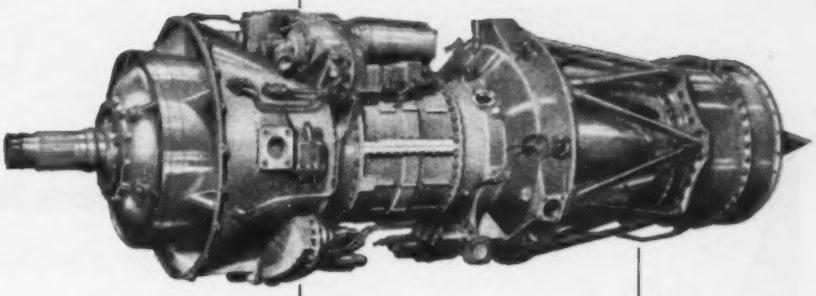
OFFICIALLY but unhelpfully described as "a new gimmick," special equipment carried on U.S.A.F. Sabres is believed to be largely responsible for the fact that in the first fortnight of this month no fewer than 44 Mig-15s were destroyed over N.W. Korea. This exceeds the previous best total for any full month.

U.S.A. to Make "Sling-shot"

ORDERS have been placed with two American firms for manufacture of the British "Sling-shot" steam catapult first tested in the light fleet carrier H.M.S. *Perseus* in 1949. The invention of Cdr. (E) C. C. Mitchell, O.B.E., the catapults have been built by Brown Brothers and Co., Ltd., of Edinburgh, who, it is believed, will also deliver some components for the initial American output. The U.S. manufacturers are the McKiernan-Terry Corp., of Harrison, N.J., and the E. W. Bliss Co., of Canton, Ohio. The first American installation will be in the U.S.S. *Hancock*, and four Sling-shots will be used in the 60,000-ton *Forrestal*.



WHY WORRY ABOUT WIDTH? Pan American Airway's DC-4 based at London Airport for ferrying spares to the Continent and Middle East may sometimes be seen with an airscrew blade protruding from a blanked-off window and, on the port side, from a slot in the door. The interior view shows the ingenious method of stowing this awkwardly shaped cargo. Maintenance foreman P. Dunstan thought it out.



ELAND

A 3000 e.h.p. single-shaft gas turbine for single-rotation propellers developed to give exceptionally low fuel consumption — for example 0.49 lb/bhp/hr at 350 m.p.h. and 30,000 ft.

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Congratulations to Saunders-Roe

on the "Princess" Flying Boat — the largest British aircraft ever built. The "Princess" is powered by ten Bristol Proteus II turbo-prop engines.

Shell and BP Aviation Service

have supplied fuels and lubricants for the "Princess" at all stages of her development.

HERE AND THERE . . .

Disputed Score

SPEAKING in Auckland, N.Z., last week, Air Chief Marshal Sir Keith Park said that grave injustice had been done to Battle of Britain fighter pilots by those who accepted unquestioningly the story that only 56 German aircraft were shot down on September 15th, 1940. Sir Keith (who commanded No. 11 Group at that time) said he fully agreed with A.V-M. Sir Hazleton R. Nicholl, who—in a letter to *The Times*—had criticized the B.B.C. and others for accepting the German claim. Sir Keith, however, added that he did not support the Fighter Command claim of 185 enemy aircraft shot down: there might have been an "overlap" of some 20 per cent, making the figure about 148. "It is high time someone corrected recent statements," added Sir Keith.

Models on Show

MORE aircraft models than in any previous year will be seen at The Model Engineer Exhibition, to be opened by the Duke of Edinburgh on October 20th at the New Royal Horticultural Hall, Westminster. Flying scale models to be shown include representations of the Spad, H.P.42 *Heracles*, Hind, Gloster 4B, Ambassador, Spitfire 5B, Hunter and Javelin. Control-line models include a 40 m.p.h. delta and the *Tinaflyte* aircraft which holds the Roland Scott Class 1 speed record of 80 m.p.h., and among the numerous non-flying models are Fairey F.D.1 and Avro 707A deltas. Prize-winning models from the R.A.F. Model Aircraft Association contests, and a number of sailplanes, will also be shown. The exhibition will be open daily (Sundays excepted) until October 29th, from 11 a.m. to 9 p.m.; admission is 3s (children under 14, 1s 6d).

GLIMPSE INTO THE FUTURE: This pleasing new study of the Bristol 173 helicopter (two Alvis Leonides—prototype for B.E.A.'s 13-seat transport—conveys a very definite "airliner" impression.

HIGH-LEVEL INTEREST: Senior M.o.S. officials recently made a special visit of inspection to Marconi's Wireless Telegraph Co., Ltd., at Chelmsford in order to examine new types of equipment. Left to right: Mr. G. M. Wright, Marconi engineer-in-chief; Mr. L. A. Sweny, manager, aeronautical division; W/C. R. R. Stanford-Tuck, sales manager, aeronautical division; Mr. S. S. C. Mitchell, C.B., C.B.E., Controller of Guided Weapons and Electronics, M.o.S.; Mr. F. S. Barton, Principal Director of Electronics Research and Development; and Mr. F. S. Mockford, Marconi commercial manager.

IN BRIEF

FROM Vickers, Ltd., comes the announcement that Viscount Knollys, G.C.M.G., M.B.E., D.F.C., has been appointed an additional member of the board of directors. During World War I he served in the R.F.C., and from 1943 to 1947 was chairman of B.O.A.C.

* * *

Radio Interference Suppression as Applied to Radio and Television Reception is the title of a new practical handbook written by G. L. Stevens, A.M.I.E.E., and published at 10s 6d for *Wireless World* by Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1.

* * *

H. M. Hobson, Ltd., announce that Mr. L. S. Greenland, A.M.I.Mech.E., A.F.R.Ae.S., becomes chief designer in succession to Mr. T. Simpson, A.F.R.Ae.S., who was appointed assistant managing director last January. Mr. Greenland has been assistant chief designer since 1942. Mr. G. O. Frampton becomes chief draughtsman in succession to Mr. A. S. Plumb, now technical executive.

* * *

Licencees in Great Britain for the Solar Aircraft Company's "Solaramic" coatings for gas-turbine "hot" parts and similar applications (described in *Flight* of August 1st) are Ferro Enamels, Ltd., Wombourn, Wolverhampton. Incidentally, Solar's president, Mr. Edmund T. Price, is now on a visit to Europe, accompanied by Admiral Wilder D. Baker, one of the executives.

* * *

From Easco Electrical, Ltd., Brighton Terrace, London, S.W.9, comes a leaflet describing their "Eascolyte" water-activated life-jacket lights, made in two types. One, approved for civil-aircraft use, gives 20-22 hours' light; the other (for yachtsmen, etc.) has an 8-hour duration.

* * *

Chamberlain Industries, Ltd., Staffa Works, London, E.10, notify increased output of their welded-steel-tube, hand-operated 25 cwt mobile shop-crane.

* * *

Radiovisor Parent, Ltd., manufacturers of photo-electric equipment, announce that they have appointed J. Broughton and Son (Engineers), Ltd., of 234 Pershore Road South, Kings Norton Factory Centre, Birmingham 30, sole selling-agents for their photo-electric press-brake guard. All other Radiovisor products are still handled by Radiovisor Parent, Ltd., from their H.Q. at 1 Stanhope Street, London, N.W.1.

SHAPE of WINGS to COME

A Summary of Mr. D. Keith-Lucas's Lecture at the British Association Meeting

ON September 8th, Mr. D. Keith-Lucas, B.A., M.I.Mech.E., F.R.Ae.S., chief designer to Short Bros. and Harland, Ltd., read a most instructive paper before the British Association at their meeting in Belfast. The title was *The Shape of Wings to Come*. Mr. Keith-Lucas began with a mention of the preoccupation of the British industry with the winning of the war, recalling that Lippisch was working on a high-speed delta design even before the war. In passing he also mentioned the more recent Hurel-Dubois high-aspect-ratio lightplane, and then went on to review the reasons which have led to the swept-back, crescent and delta wing-forms.

The lecturer first explained the purpose of sweep-back. It really amounted to no more than saying that we could resolve velocity into two components : one at right angles to and the other along a wing, and that we could then neglect the flow along the wing. In practice, due to boundary layer and end effects, the advantage which could be realized was only about half of that indicated by this over-simple treatment. But in spite of that, sweep-back had two very important contributions to offer. In the first place it reduced the adverse effects of compressibility, and in this respect a swept wing behaved in much the same way as a much thinner straight wing. In the second place, sweep-back postponed the compressibility effects to higher speeds and, if the angle of sweep was sufficient, could even postpone them to well above the speed of sound, which was something that thinness by itself could not do.

"Sweep-back was first introduced into aircraft design for quite a different reason," said Mr. Keith-Lucas. With the development of cantilever monoplanes designers began to think in terms of thicker wings. As the size of aircraft increased, it became tempting to try to submerge the fuselage by putting it athwartships in the wing, so saving the weight and drag of the fuselage. It also reduced the bending moments at the wing roots, arising from the upward lift forces, by spreading the load more uniformly across the span. The obvious development of this idea had been to dispense with the tail, because there was no longer anything to support it. The longitudinal stability of the aircraft was then restored by sweeping the wings back, and in effect, carrying the tailplane on the wing-tips. The lecturer mentioned the Hill Pterodactyl of 1925 as a pioneer effort in this direction, and illustrated a Short project of 1945 for a transatlantic airliner to much the same specification as the Brabazon.

Boundary-layer suction next came in for discussion. The objection to using thick wing-sections was that the drag became unduly high. A thick boundary-layer of relatively stagnant air built up around the wing and was shed as a wake from the trailing-edge. The drag could be very much reduced if this boundary-layer was sucked away near the trailing-edge of the wing, and it became possible to use very thick sections without incurring any penalty in drag over normal thin sections. The engineering difficulties were considerable, because the quantity of air which had to be removed was very large; but it could be done, and it made the all-wing design both feasible and attractive.

A typical aerofoil section for a suction wing is illustrated and also a proposal for a suction wing airliner made by Mr. T. S. Keeble at the Third Anglo-American Aeronautical Conference. On the basis of results obtained from test with the experimental glider flown by the Australian Aeronautical Research Laboratories, such an airliner would carry forty per cent more load and would be forty per cent faster than one designed on conventional lines while still consuming no more fuel for the same range.

Mr. Keith-Lucas said that we had got so used to the conventional arrangement of aircraft with a straight wing, a long slender fuselage and a tail that we were apt to look on a tailless design as something of an unnatural freak. But if we observed nature carefully, we noticed that seagulls and ducks and many other birds were, in effect, tailless, at least in straight flight, while bats were tailless at all times, and were probably the most manœuvrable of all flyers.

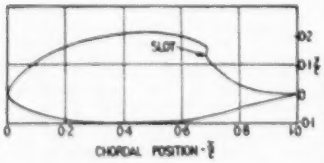
There was a strong argument for a tailless design on structural grounds. In a pull-out from a dive or in a high-speed turn, there was a large upload on the wing and usually a down-load on the tail. On a conventional tailed aircraft with swept-back wings, the moments due to these loads cancelled each other out only through the long path up the fuselage and the wing to the centre section. With a tailless design the down-load of the tail occurred at the wing-tips, and so we not only avoided the need for a structurally strong and stiff fuselage, but reduced the bending moments in the wings also. There was therefore a potential gain in structure weight as well as in drag, which had to be offset against the fact that the "tailplane," if it could be so called, had a shorter moment arm and therefore had to be larger.

The lecturer then referred to the controversy over the merits of the all-wing, tailless aircraft and the high-aspect-ratio vee wing with long slender fuselage. Examples were the Avro delta and the Boeing B-47. There were all sorts of considerations which led to one choice or the other : what to do with the engines; where to put the fuel; what wing area was needed for landing or for manœuvrability at operating altitudes; how heavy would the structure be; and how was the wing going to distort or deflect at high speed.

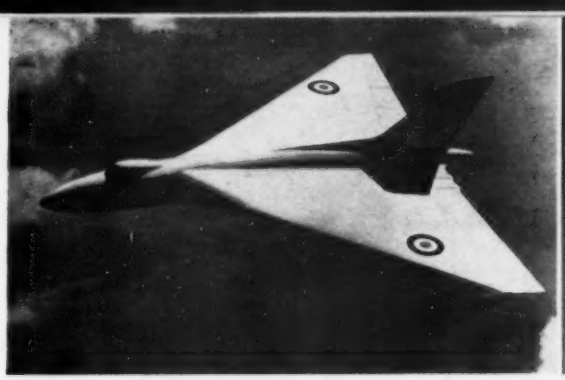
Aero-elastic effects were next discussed. The lecturer said : "We have already seen how sweep-back was first introduced as a means of providing longitudinal stability and control on tailless aircraft. The odd part of the story is that nowadays we are concerned by the ill effects of sweep-back on stability, both longitudinal and lateral." The instability showed itself in various ways, the most pernicious of which were aero-elastic effects, tip stalling and rolling moment due to side slip. It was the aero-elastic effects, the aerodynamic effects of structural distortion in flight, which often had the biggest influence on the choice of wing plan-form.

As an example, the lecturer mentioned aileron reversal. "Consider," he said, "the starboard wing of an aircraft on which the aileron is deflected downwards with the intention of increasing the lift on that side and making the aircraft roll to port." On a perfectly rigid wing the resultant rolling moment would increase as the square of the speed, but in practice wings could not be perfectly rigid and the behaviour was more complicated. The air loads due to the downward aileron produced a twist in the wing—up at the trailing-edge and down at the nose—so that the wing lost incidence and lift and so produced a rolling moment which was in the opposite direction to that due to the aileron itself. The amount of the twist increased with speed because the air loads became greater in comparison with the lessened restraint of the wing structure. There came a speed at which the effect of twist exceeded that due to the ailerons, and the aircraft rolled in the opposite direction to that intended by the pilot.

The loss of tip incidence resulting from wing flexure had another very important effect on the handling qualities of swept-wing aircraft. Taking the case of a pull-out from a high-speed dive, Mr. Keith-Lucas said that the pilot pulled the stick back to raise the nose of the aircraft and increase the incidence of the wing; he then expected that if he held the stick fixed the aircraft would pull out at a constant normal acceleration, that was, with a flight path of a constant radius of curvature. But what actually happened was that after the pilot had pulled the stick back it took



(Left) Suction-wing aerofoil section. (Right) A proposal (T. S. Keeble, 3rd Anglo-American Aeronautical Conference) for a suction-wing airliner.



The shape of swept-back wings, delta or vee, the subject of the new controversy. The Avro 698 and the Boeing B-47. It is neater to tuck everything in the wings, but pods have certain advantages.

a moment before the aircraft attitude could change and the lift build up on the wing. When this happened the wings bent slightly upwards and shed lift at the tips. On a swept-wing aircraft, the tips were well behind the c. of g. and this loss of lift therefore meant a nose-up change of trim, tending to make the aircraft tighten into the manœuvre. In other words, an increase in lift caused a further increase in lift and there was therefore a loss of stability which could have serious consequences on a highly swept wing of high aspect-ratio. This effect the lecturer called "wash-out due to flexure." He remarked that some wash-out was often built into a straight wing to improve the stalling behaviour.

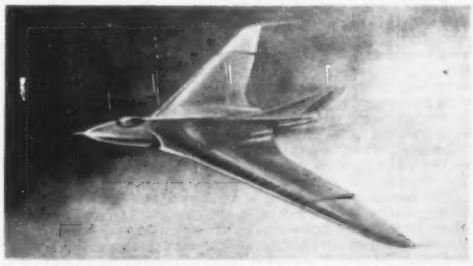
Mr. Keith-Lucas next turned to the aero-isoclinic wing [in which he is known to be very interested]. The term, he said, was used by Prof. G. T. R. Hill to indicate a wing of which the incidence or inclination to the air flow remains constant along the span in spite of flexural distortion. Mr. Keith-Lucas said that if one chose precisely the right point at which to apply the load one could bend the wing with no change of incidence along the span. One way of doing this was to place the torsion box well back in the wing so that the air loads acting at about the quarter-chord line had a considerable moment arm about the torsion box. Even so, the torsional stiffness of the wing might have to be less than usual so as to get the right relationship between twist and flexure.

Problems of aileron reversal then had to be faced, and it was probably necessary to use either rotating wing-tip controls in place of conventional ailerons, or to use spoilers of some sort. The lecturer's preference was for rotating wing-tip controls because, if used as elevators as well as ailerons, they offered a means of overcoming tip-stalling by the simple expedient of increasing the wash-out as the wing incidence increased. They could also be expected to provide excellent control at high Mach numbers.

Another solution to the problem was to crank the wing-tips forward from the rest of the wing so that the load on the tips was forward of the axis of the wing. This was the crescent wing which was pioneered by Arado in Germany and had since been developed by Handley Page in England. It was quite an attractive solution, because it also lessened the tendency to tip stalling by reducing the sweep-back over the critical tip portion. There was necessarily some weight-penalty on the structure due to the crank, but it did not need to be large, particularly as the crank was fairly near the wing-tip. Another slight disadvantage was that the tips had to be very thin in order to make up for the loss of sweep.

The aero-isoclinic wing and the crescent wing both enabled the designer to use higher aspect-ratios than would otherwise be possible, and they showed to the greatest advantage when the design conditions were such as to demand high aspect-ratios.

Before going on to discuss the delta wing, Mr. Keith-Lucas mentioned forward sweep and the combination type of "M" wing of which the gannet seabird provided a natural example. He also described the "pernicious phenonema" known as wing divergence. At first sight it would appear, he said, that an increase in incidence forward of the c. g. would have the same effect on

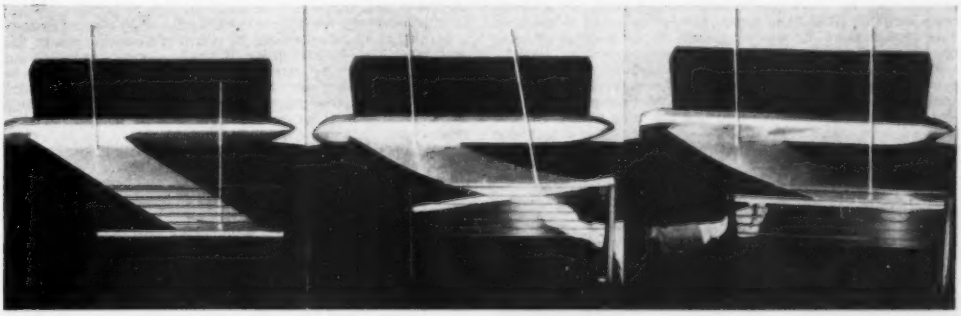


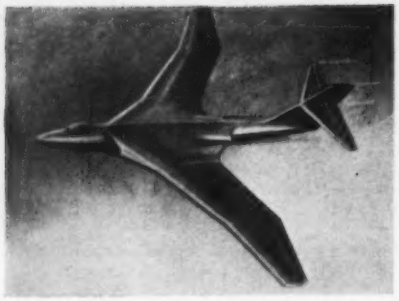
Aircraft with rotating-wing-tip control.

stability as a decrease in incidence aft. This was not, in fact, so, because the process tended to be self-energizing, an increase in lift causing an increase in incidence which caused a further increase in lift and so on until and at some speed the wing would fail.

Regarding aero-elastic problems, the lecturer said that the simplest solution of any was to make the wing really stiff by keeping the aspect-ratio small, and the delta wing exemplified by the Avro 707 was the logical result. It offered very considerable structural advantage over other shapes. There was plenty of room to house a really satisfactory structure and to place the spars just where and how the designer wanted them. Subsidiary advantages were that the small aspect-ratio had the property of reducing the effects of compressibility and of making the tendency to tip-stalling less severe. Moreover, there was room in the wing to house the engines, fuel and undercarriage, and the cut-outs which

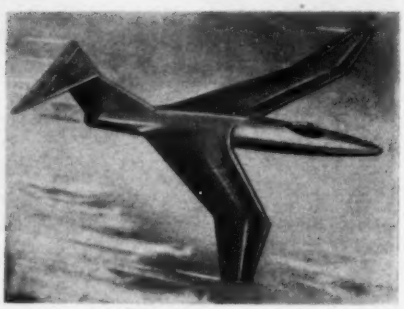
Three illustrations of distortion of a model swept-back wing. Left, undeflected; centre, not twisted but with loss of incidence at the tip, right: no loss of incidence at the tip but the wing is twisted.





An example of a crescent wing design.

The swept-forward crescent wing.



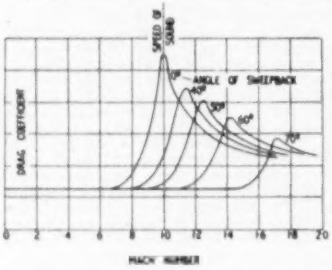
SHAPE OF WINGS TO COME . . .

were necessary to allow retraction were not nearly so serious as on a narrow wing. These qualities the lecturer compared with contrasting arrangements on the Boeing B-47.

But in spite of its virtues the delta wing was not the answer to all our troubles. Strut-mounted engines might look untidy, but they were favourites of the maintenance engineers. The crews of combat aircraft might also be partial to them on the grounds that the consequences of an engine fire were less serious. Engines buried in a delta wing might present a beautifully clean installation, but in a large aircraft the jet pipes and/or intake ducts were undesirably long. What was more important was that when altitude requirements demanded a wide span, the wing area of a delta became unnecessarily large, and it had to be paid for in the most precious of aeronautical currency, namely, drag and weight. The weight-saving on the basic structure could easily be nullified by the weight of the skin sheeting to cover so large an area plus the weight of the large chordwise ribs, and most serious of all, by the weight of fuel that had to be burned in overcoming the skin-friction drag of the additional wing area.

The conclusion which could be drawn was that there was a strong case for the delta wing in the smaller sizes, and especially when the sweep-back was 60 deg or more. On very large aircraft of, say, 200,000 lb weight and upwards, the delta became uneconomical and a vee wing with strut-mounted engines was then the obvious choice.

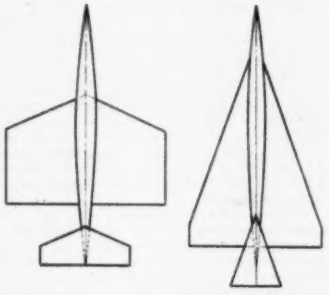
Dealing next with supersonic shapes, the lecturer said that for very high speeds, where the degree of wing-sweep required would be impracticable, it might be better to have no sweep at all. Put another way, we either had to have enough sweep to delay the compressibility troubles to speeds beyond the range in which we were operating, or else we could hurry on the troubles by using no sweep at all so that all was well again at the operating speeds.



General effect of sweep-back on the drag of an aerofoil at high Mach numbers.

Commenting on the curves illustrated above, indicating the general effect of sweep-back on the drag of an aerofoil at high Mach numbers, Mr. Keith-Lucas said that if, for example, one took a Mach number of 1.6, it was seen that the wing with the lowest drag was that with the greatest sweep, but that the next lowest was the straight wing.

If we favoured the straight wing we had to make it very thin. It seemed that before long we should be forced to use thickness/chord ratios as low as 3 or 4 per cent, and the wing would have to be of small aspect ratio in order to be sufficiently stiff and strong. "I imagine," said Mr. Keith-Lucas, "that it will be worth while to provide just sufficient sweep-back to overcome any tendency to wing divergence." The illustration immediately below shows two alternative plan forms for a supersonic aircraft of which the one using acute sweep-back is theoretically preferable.



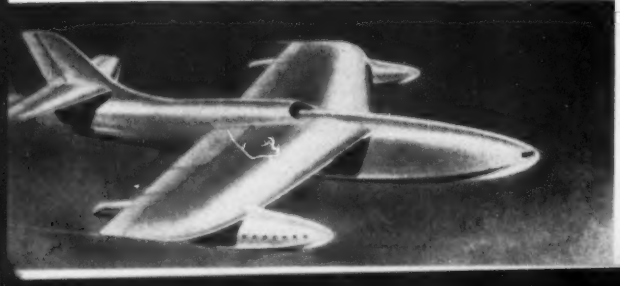
Possible plan-forms for supersonic aircraft.

Slow-flying and landing problems were next discussed by the lecturer, who remarked that take-off might also present a problem; but the thrust necessary to fly at very high speeds was likely to be adequate for unassisted take-off unless the wing lift was very poor or the wing loading very high.

The real problem was likely to be in landing. Here was the challenge and all sorts of mad ideas came to mind. Should the wings be unswept for landing as on the experimental Bell X-5? Might it be possible to swivel the engines round to give lift instead of propulsive thrust? Perhaps the best way out of the difficulty was to avoid it altogether, which we could do if we arranged for the high-speed aircraft to link up with the parent aircraft in flight. We might even consider stopping the aircraft in flight by air brakes and forward-firing rockets, and then letting it down on parachutes or by a retractable rotor. We might be forced to put up with high landing speeds and use arrester gear; alternatively, we might accept high landing speeds if we made the aircraft into a flying-boat and alighted on water—Ernest Stout had suggested the use of this type—and we might be able to improve upon it still further by the use of hydro-skis instead of the planing bottom.

Mr. Keith-Lucas concluded by referring to atomic power. He said the atomic-powered airliner might be a possibility today, but it would have to be extremely large and would probably be uneconomical on account of the enormous weight of the screening necessary around the reactor unit. We could argue from that single premise that the aircraft ought to be a flying-boat. The reactor unit and engine would be in the hull and the passengers would have to be housed in the wing or wing-tip floats.

But we had been applying the old arts of aircraft design to a new form of propulsion, whereas a much more radical approach was needed. What shape the atomic-powered aircraft would be was a subject deserving much thought when we knew enough about the characteristics of the engine. There should therefore be a close understanding between the atomic-research establishments and the aircraft industry. Unnecessary secrecy would deprive the country of the chance to lead in the atomic age.



Atomic-powered flying-boat—as it probably will not be.

1,640

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The Princess!

What has 1,640 in common with the new Princess? Imagine one thousand, six hundred and forty Princess flying boats placed end to end, the total length would total approx. 46 miles — and 46 miles is just about the amount of Pirelli-General cable installed aboard the first Princess.

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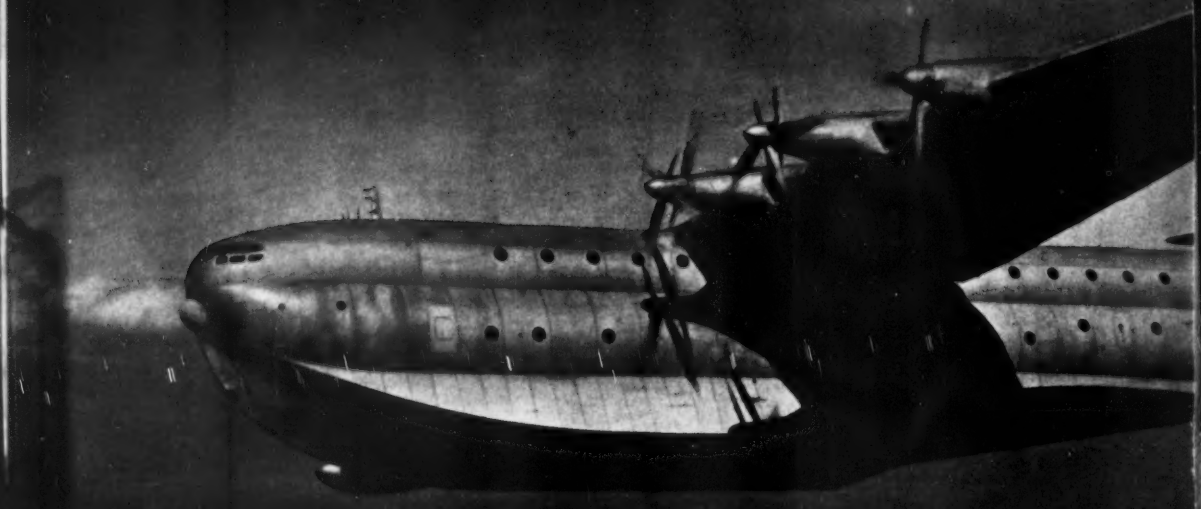
The propellers of the Princess



For the efficient conversion of some 30,000 shaft horse power into thrust, the Saunders-Roe Princess flying-ship uses

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The Princess

DESIGN DETAILS OF THE GREAT SAUNDERS-ROE FLYING-BOAT

Liners of two elements: The Saunders-Roe Princess, a "marine airliner" in the truest sense of the term, passes R.M.S. "Mauretania" in the Solent.

IN a recent debate on air-transport policy in the House of Lords, Lord De L'Isle and Dudley summed up by saying that civil aviation had become, or was becoming, what sea power used to be, and it was the Government's desire to see that Great Britain had in this important and expanding field a share which was large, because that was our due. It is, however, noteworthy that during the same debate Lord Sempill said he was shocked that no reference had been made to flying-boats and declared that air transport must for technical and practical reasons be ever more concerned with this class of aircraft.

Lord Sempill is a far-sighted man who is doing his country a service in keeping the flying-boat issue alive. For our part we make no apology for our advocacy of marine aircraft; on the contrary, *Flight* has always championed the cause of the flying-boat, and will continue so to do. This present uninterestedness on the part of operators toward the flying-boat is temporary, and the reasons for it are not difficult to see. Before the war, the great trunk routes of Imperial Airways were dominated by boats: they operated efficiently, economically, and to the great satisfaction of travellers. During the war, the world became spotted with thousands and thousands of acres of concrete, laid down so that military aircraft could operate from convenient bases. During the war, the performance of all new aircraft, transports included, went up considerably.

The war finished, airlines of all nations started to untangle their disrupted organizations and get back to competitive commercial operation. Almost exclusively, the only aircraft available to them were American and, of course, they were land-planes. To their credit, B.O.A.C. continued for a time to use boats, but despite the passenger appeal of the flying-boat, it was not able to compete with the much greater speed of the newer landplanes. Furthermore, whereas the maintenance of the marine bases was a direct charge on the operator, the land airports had largely been provided as a military necessity, and imposed no particular burden on the users. So the boat was forced out of the picture.

Certainly, the pro-boat voices continued to urge their case—as they still do—and to the extent that the Saunders-Roe Princesses exist in varying states of completion, the voices must be accorded persuasiveness. But the hard fact is that so long as the landplane is subsidized by nationally provided airports no operator will willingly change over to boats if he has to bear the provisioning cost of the marine bases, comparatively slight as they are. In addition, the economic capability of an aircraft is a more or less direct function of its efficiency as a flying machine, and it is not until the really large sizes are reached that the flying-boat shows advantage over the landplane. Modern developments have altered the relationship somewhat, but not to an extent sufficient to invalidate the basic argument.

What, then, is there to be said for the flying-boat's future? Chiefly two things. First, aircraft have steadily been getting bigger and bigger, and there is no evidence to show that a halt will be called in this trend. As size increases, the boat comes into its own. Second, throughout the 50 years of aviation history, military and civil aircraft have run on parallel courses, the military aircraft leading and the civilian machine following on. In fact, it is true to say that, in the main, commercial aircraft have been possible only because aeronautical development has been paid for as a military necessity. That condition still obtains, and is likely to continue for some little time. But it is now becoming increasingly apparent that the future paths of military and civil aviation will diverge. It is possible that, in not so very many years, there will no longer be a military requirement for gigantic runways; when and if such a time does come, the chief argument against the flying-boat will vanish.

In the meantime, however, the authority which governs Britain's air interests is faced with a difficult problem. On the one hand, there exists neither civil nor military demand for boats *at the moment;* this, however, is not to say that such demand will never be made. There is, indeed, even now a military necessity for the flying-boat as a fighting and transport vehicle which can operate at short notice to and from unprepared bases. On the other hand, the design skill and priceless know-how which this country possesses in the marine-aircraft field must not be allowed to become atrophied. The only way to stop such incipient decay is to keep boat-building alive. But the Treasury of so penurious a country as Great Britain today is understandably reluctant to pay for the development and building of aircraft for which there exist no present or immediate future demand. One possible answer is that the large flying-boat ought properly to take the place of the troopship. An exceedingly cogent case can be made out for such a course, although this is not the time or place to examine it: be it sufficient to state that in terms of cost, of time, and of the fighting efficiency of its passengers, the flying troopship shows powerful advantages over its surface-going counterpart.

Whether, in the final event, the Princesses will be operated

"Flight" photograph

A near-plan-view will emphasize any æsthetic shortcomings of an aircraft. The Princess emerges triumphantly from such a test.

The Princess . . .

as troop transports is very much a moot point. In our view, it seems absurd that the taxpayer should have had to foot a bill for a few million pounds, and the objects bought with the money be forced to lie idle when they could without difficulty be put to very real use. Another aspect of the situation—and an important aspect, too—is that a flying-boat is only as good as its crew. A first-class crew can do things with a flying-boat at sea which simply have no counterpart in operational flexibility with landplanes; in the air, of course, the two types obey the same rules. But the danger today is that the number of boat crews are diminishing in Coastal Command, whilst in B.O.A.C. the erstwhile crews are entirely dispersed; worst of all, there exists no machinery for training civil aircrew in the art of flying-boat operation. It is, truly, a gloomy picture, but it is absolutely certain that, unless far-sighted appreciation of the long-term effects is forthcoming shortly, and action initiated to change the present trend of events, the final picture will be sombre to the point of despair.

But let us now have a look at the Princess herself: an aircraft of which Great Britain ought well to be proud, and would indeed be proud if given the opportunity to see what the great flying-boat is capable of doing.

Design History. The conceptual progress leading up to the Princess was gradual and logical in its development; there was no sudden decision to build a very big aircraft. In the late thirties Saunders-Roe were considering design-studies for long-range transoceanic boats as natural followers-on to the existing types, and using four high-powered piston engines. These ideas, in fact, accorded fairly closely with the specification for the Shetland—a fine boat in which Saunders-Roe co-operated with Short Brothers. In pursuance of greater range, studies were extended to Eagle- and Centaurus-powered six-engined types of the 200,000lb order, and these led logically to consideration of variants of even larger size and designed to take advantage of the new gas turbines.

This was the genesis of the Princess as we know it today. Power installations in a number of varieties were investigated, not only in types of engines—for example, Clyde, Python, Tweed, Cobra and Proteus—but in coupled and single combinations according to power output, the desired criterion being the distribution of some 30,000 h.p. between six thrust-stations. The design of the Princess as an aircraft of 315,000lb gross, and with ten Bristol Proteus turboprops arranged in four coupled pairs and with outboard single units, was initially stabilized early in 1947.

The Hull. Structurally, the hull is a comparatively straightforward example of conventional practice applied to the form demands of a double-bubble pressurized hull, and an orthodox chined planing bottom. Frames are spaced at a constant pitch of 28in throughout the length of the hull except in the region of the rear-spar frame where, because of spar spacing, the frame centre distance had slightly to be modified. The spar and inter-spar frames are also sloped back 1 min 50 deg.

In the top bubble, the frames are notched for the folded Z-section stringers; in the lower bubble and between the lower deck and the chine, the folded Z-stringers are intercostal to the frames; but in the planing bottom the stringers are continuous extruded Z-sections, on the crowns of which ride the lower edges of the bulkhead frames. In general, every third frame in the under-body of the hull forms a watertight bulkhead, the stringer interstices being filled with semi-hard sponge rubber to this end. The bulkhead frames in the planing bottom are structurally similar whether watertight or not, and comprise diaphragms (the gauges of which increase outboard to compensate for the reduced depth) stabilized by top-hat and angle-section verticals, some of which are doubled on opposite faces.

In the top bubble, throughout the length of the hull, the frames are pressed channel-section members, whereas in the lower bubble, the frames in the front and rear thirds of the hull, whilst also of pressed channel-section, carry a reinforcing plate on their free flanges. The middle third of the lower bubble has I-section frames in which a plate web is riveted to extruded T-booms. Stringer/frame attachment is made through extruded cleats.

The main frames at the spar stations are of immensely strong construction. The forward frame, registering with the front spar, comprises essentially two main verticals in the form of doubled extruded top-hat sections "crown to crown" which, as they run down from the wing-attachment point, are progressively machine-reduced to channel sections. Sandwiched between these extrusions and through-riveted to them, are plate diaphragms running out to the hull sides, and radially stabilized by pressed channel members of progressively increasing depth. At their heads, the main-frame vertical members are reinforced with h.t. steel doubling plates, through-bolted to distribute the load concentration of the wing attachment pins.

The upper portion of the hull is cut out for the wing, and is "edged" with an extruded-channel gunwale-member to which the wing is bolted at various chordal stations to take out drag loads. Lift and side loads are taken through the four h.t. steel attachment pins. Two 4½in diameter light-alloy tubes run down athwartships from the wing attachment points to meet on the centre line at upper deck level and, with the deck and upper hull structure, so complete the triangulation. The rear main frame is basically similar to its forward fellow, and differs only in detail.

At the upper and lower deck levels, Y-section longitudinal members unite the skin panelling of the deck structures, and serve to distribute hull pressurizing strains into the decks as tension, and into the under-body walls as shear. The chine joint is a heavy-gauge rolled plate angle, to which the side and bottom plating is riveted, whilst the keel is an anchor-section extrusion, the crown of which is rebated for the plating; at the "step" a transfer beam bridges the discontinuity of the keel joint, this region being the most heavily loaded of the entire planing bottom.

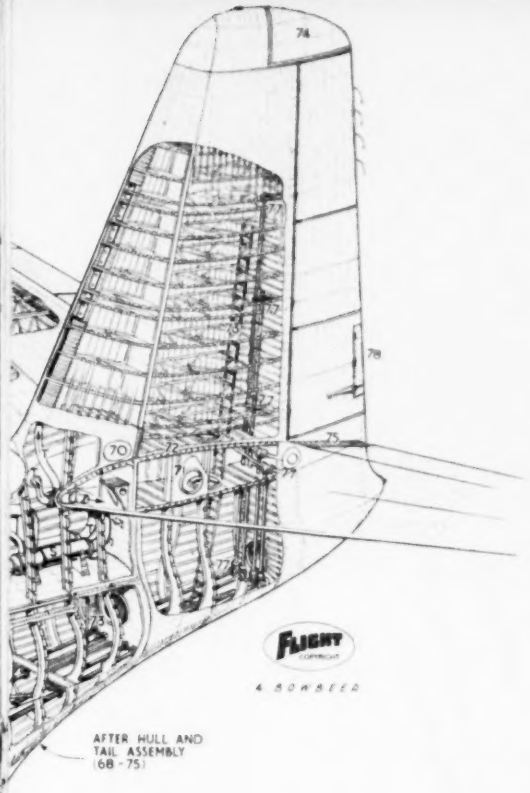
The Princess has a vestigial step—actually $\frac{1}{16}$in—the fore-body plating being riveted to a ¾in-thick solid strip of D.T.D. 683 curved to the plan profile of the step, with the after-body plating picking up to an internal plate, which in common with the fore body plating is riveted to the solid strip.

The upper deck is floored in 18-gauge sheet, carried on fore-and-aft intercostal stringers of Z-section, running between thwartship beams of channel section at frame stations. The extreme forward portion of the upper deck structure, i.e., that forming the roof of the mooring compartment in the lower nose, is a sealed "lower-jaw" complementing the pressure bulkhead below and to the rear of it.

The lower deck structure has to take pressurizing loads, and is, therefore, a particularly strong fabrication. The floor panelling of 18-gauge sheet is carried on six main fore/aft beams, the extruded T-booms of which are continuous through cut-outs in the under-body bulkheads, although the plate webs are intercostal. Running athwartships on top of the I-beams are extruded I-beams of smaller scantlings which directly support the floor panelling in conjunction with pressed channel fore/aft intercostals. At various stations down the length of the hull there are 11 tubular stanchions of 3in diameter anchored head and foot to the deck structures.

As already noted, the bulkhead dividing off the mooring compartment is a pressure-bearing structure and, being a flat surface, is, therefore, patently strong. On its after face, the bulkhead is stiffened by four vertical piers of I-section, intercostal between which are pressed channel horizontal stabilizing members: the outboard stabilizers are pressed Z-section strips which radiate normal to the tangent of the skin curvature. Access to the mooring compartment is through a pressure-tight door in the centre of the bulkhead.

At the rear of the hull, cabin pressure is taken by a pair of intersecting dome bulkheads plated in gore form, the lower dome having a pressure-tight manhole in the centre for access into the extreme tail of the hull and up into the lower fin. The structural joint between the hull proper and the tail assembly is made at this station with through-bolted, extruded boundary-members. Rearward of the joint, the skin panelling is carried on three former frames comprising channel-section boundary members notched for the stringers attached to them with plate shear-cleats. The only lateral bracing consists of a pressed channel beam at the bubble intersection and a "shear deck" which is in effect a continuation of



AFTER HULL AND TAIL ASSEMBLY (68 - 75)

POWERED CONTROLS (76 - 79)

REFERENCE

AIR-CONDITIONING SYSTEM

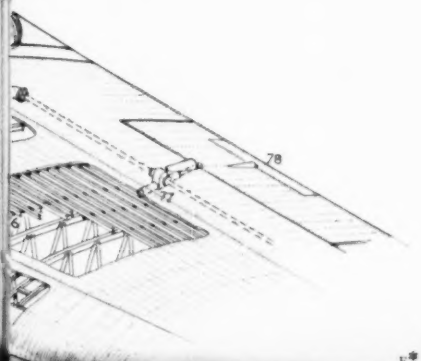
- A — AIR INTAKE
- B — HOT AIR FROM JET PIPE HEAT-EXCHANGERS
- C — AIR PRESSURIZING, HEATING, COOLING, REFRIGERATING UNIT
- D — RECIRCULATION FANS AND MIXING CHAMBERS (UNDER CENTRE-SECTION)
- E — CONDITIONED-AIR DELIVERY-DUCT (UPPER DECK)
- F — CONDITIONED-AIR DELIVERY-DUCT (LOWER DECK)
- G — AIR FLOW-PATH BETWEEN INSULATION AND CABIN TRIM TO—
- H — —CENTRAL DELIVERY PANELS (UPPER DECK)
- — —CORNICE DELIVERY PANELS (LOWER DECK)
- J — RECIRCULATION INTAKES
- K — CONDITIONED AIR TO FLIGHT DECK
- L — CABIN PRESSURE-RELIEF VALVES

WING ANTI-ICING

- M — AIR TO JET-PIPE HEAT-EXCHANGER
- N — DISTRIBUTION VOLUTE
- P — HOT-AIR DELIVERY DUCT TO LEADING EDGES
- Q — INTAKE HEATING TRACT

TAIL ANTI-ICING

- R — AIR INTAKE
- S — PARAFFIN COMBUSTION-HEATERS
- T — HOT AIR TO LEADING EDGES
- U — AIRSCREW CYCLIC-DE-ICING SHEATHS



REFERENCE

PLANING BOTTOM

1. WATERTIGHT BULKHEADS
2. STEP
3. FRONT-SPAR MAINFRAME
4. REAR-SPAR MAINFRAME
5. BOTTOM STRINGERS, CONTINUOUS BELOW FRAMES (SIDE STRINGERS INTER-COSTAL)
6. BEACHING CHASSIS ATTACHMENT POINTS
7. AIR VENTS (PLANING BOTTOM NOT PRESSURIZED)

MARINE COMPARTMENT

8. PRESSURE BULKHEAD
9. BOW DOOR
10. DOOR TO LOWER DECK
11. HAND-OPERATED WINCH AND HANDLE (STOWED)
12. ANCHOR (STOWED)
13. CLOUD- AND COLLISION-WARNING RADOME

LOWER DECK

14. INTERCOSTAL STRINGERS
15. FREIGHT DOOR THRESHOLD (ST'B'D)
16. FREIGHT HATCH
17. FLOOR CONSTRUCTION, FRAMES 8 TO 24 ONLY
18. BELAYING FITTINGS
19. MANHOLES TO PLANING BOTTOM
20. SPIRAL STAIRCASE TO UPPER DECK
21. MAIN ENTRY DOORS
22. ELECTRIC BILGE-PUMPS AND HAND-PUMP

FLIGHT DECK

23. UNDERFLOOR PRESSURE DOME
24. DIRECT-VISION PANEL (EACH SIDE)
25. WINDSCREEN WIPERS

SEATS

26. CAPTAIN
27. FIRST OFFICER
28. NAVIGATOR
29. RADIO OPERATOR
30. FLIGHT ENGINEERS
31. PERISCOPIC SEXTANT MOUNTING
32. RADIO AND RADAR INSTALLATIONS
33. FLIGHT ENGINEERS' THROTTLES AND PANELS

UPPER DECK

34. MAINTENANCE/ESCAPE HATCHES
35. CONTINUOUS STRINGERS
36. STEAMING LIGHT
37. S.T.R. 12c V.H.F. AERIAL IN MAST
38. SUPPRESSED AUTO D/F LOOP AD 7092A
39. PRESSURE HEAD
40. MAIN ELECTRICAL COMPARTMENT
41. FIBREGLASS BLANKET INSULATION
42. INTERIOR TRIM
43. MAINTENANCE LADDER (FIXED)

WING CONSTRUCTION AND INSTALLATION

44. FRONT-SPAR
45. REAR-SPAR
46. WING/HULL MAIN ATTACHMENT POINTS
47. CENTRE-SECTION/INNER-WING JOINT RIBS } MULTI-BOLT
48. INNER/OUTER WING JOINT-RIBS }
49. INTEGRAL FUEL TANK END-RIBS
50. SINGLE-SLOTTED FLAPS—THREE SECTIONS EACH SIDE
51. FLAP MOTORS AND SHAFTING
52. FLAP SCREW-JACKS
53. WING-TIP FLOAT OPERATING JACK
54. NAVIGATION LIGHT (WHEN AIRBORNE)
54a. NAVIGATION LIGHT (WHEN WATERBORNE
55. RIDING LIGHT
56. STRINGERS, CONTINUOUS OVER RIBS
57. MANHOLE TO CENTRE-SECTION INTERIOR
58. FIRE SUPPRESSION BOTTLES

ENGINE INSTALLATIONS

59. CONTRA-ROTATION AND REDUCTION GEARBOX
60. ENGINE AIR INTAKE
61. AIR TO OIL-COOLERS 61A
62. DRIVE-SHAFT TO AUXILIARY GEARBOX
63. DRIVE-SHAFT TO AIR-CONDITIONING UNIT
64. 126 V 39 kW GENERATORS
64a. 28 V 6 kW GENERATORS
65. OIL TANKS —
    (a) Outer engine (10 gal)
    (b) Centre engine transmission (10 gal)
    (c) Centre engine (two x 7 gal)
    (d) Inner engine transmission (10 gal)
    (e) Inner engine (two x 7 gal, behind spar)
66. MAINTENANCE HATCHES
67. LOWER COWLING/MAINTENANCE PLATFORM

AFTER-HULL AND TAIL ASSEMBLY

68. REAR PRESSURE-BULKHEAD
69. MANHOLE (LOWER DECK ONLY)
70. MANHOLE TO TAILPLANE TOP SURFACE
71. MANHOLE TO TAILPLANE INTERIOR
72. TAILPLANE MULTI-BOLT ATTACHMENT
73. MAINTENANCE LADDER (FIXED)
74. PLATE AERIAL, AD 94 M/F, H/F, RECEIVER
75. PLATE AERIAL (PORT AND ST'B'D) S.T.R. 15 H/F TRANS/RECEIVER

POWERED CONTROLS

76. ELECTRO-HYDRAULIC POWER-PACKS :—
    (a) To inner section of elevator
    (b) To outer section of elevator
    (c) To upper section of rudder
    (d) To centre and lower sections of rudder
77. SHAFT TRANSMISSION AND SCREW-JACKS
78. SERVO TABS
79. AILERON POWER-PACKS ON CENTRE-SECTION REAR SPAR

G-ALUN at her moorings off the Saunders-Roe works at Cowes. The tail belongs to sister-ship G-ALUO, and below is the S.R. A1 fighter flying-boat.

The Princess . . .

the crown of the upper bubble and which extends back to the front spar of the fin.

Tail Unit. The fin front spar is a diaphragm frame with an extruded-angle boundary member and horizontal Z-stabilizers to the web. Forward of the spar the fin leading-edge is supported on former ribs of braced and diaphragm types with conventional stringers. The fin spar is also a continuous keel-to-tip member of essentially similar construction to the forward spar, and between the spars are three intermediate frames of channel-section with plate webs and extruded-angle boundaries.

In way of the tailplane spars, continuity across the fin is given by horizontal channels with extruded angle booms and plate webs spanning the fin spars. Fore-and-aft contour members of channel-section ride on the fin intermediate frames, and support the spanwise Z-stringers carrying the skin plating of the tailplane "bridge" inside the fin.

The tailplane is built up on two spars, each of which comprises a plate web with extruded T-booms which, however, are progressively machined away to angle sections in their spanwise run. Inter-spar ribs are Warren-braced with channel struts and contour members on which ride the Z-stringers carrying the skin. The tip ribs are diaphragms. This basic structural form also applies to the leading edge, although the structure of the plating is modified to embody the distribution ducts and corrugated panels for thermal de-icing.

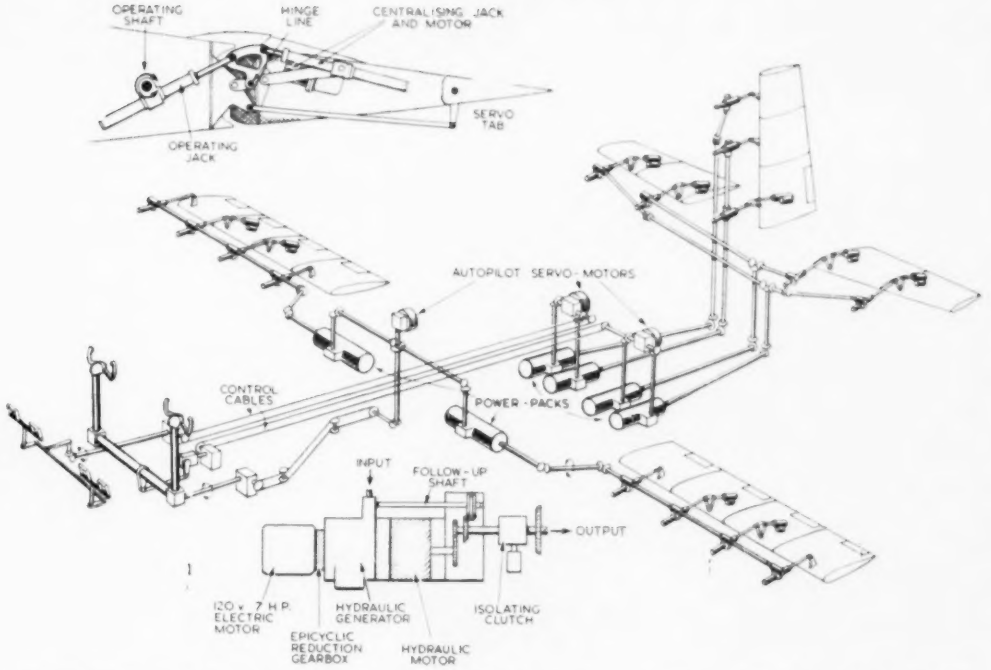
Abaft the fin rear spar the tail-cone of the hull runs up to the base of the rudder, and is built up on four pressed channel frames diagonally braced and carrying on their boundary flanges the Z-stringers which support the skin. The top of the tail-cone finishes with a diaphragm rib complementing the base profile of the rudder.

The Wing. The Princess wing is basically a Saro-modified Goldstein section, designed to give low cruising drag, but there is a transition to a modified N.A.C.A. 4415 Series section in the region of the tip, this transition being associated with a wash-out of 2 deg. Physically, the wing comprises a centre-section bridging the hull, and extending to the inboard engines; inner wings extending to just beyond the outboard single engines; and outer panels which extend to the tip floats. In plan form, the centre section is rectangular, the inner wings are slightly tapered, and the outer panels have their leading edges swept back fairly sharply by contrast to the trailing edges which are normal to the hull axis. The spars in the centre-section and inner wings run parallel at a chordwise spacing of 12ft, but in the outer panels converge progressively to the float-support rib at which point they are but 5ft 3.6in apart, thence running parallel to the tip end-rib.

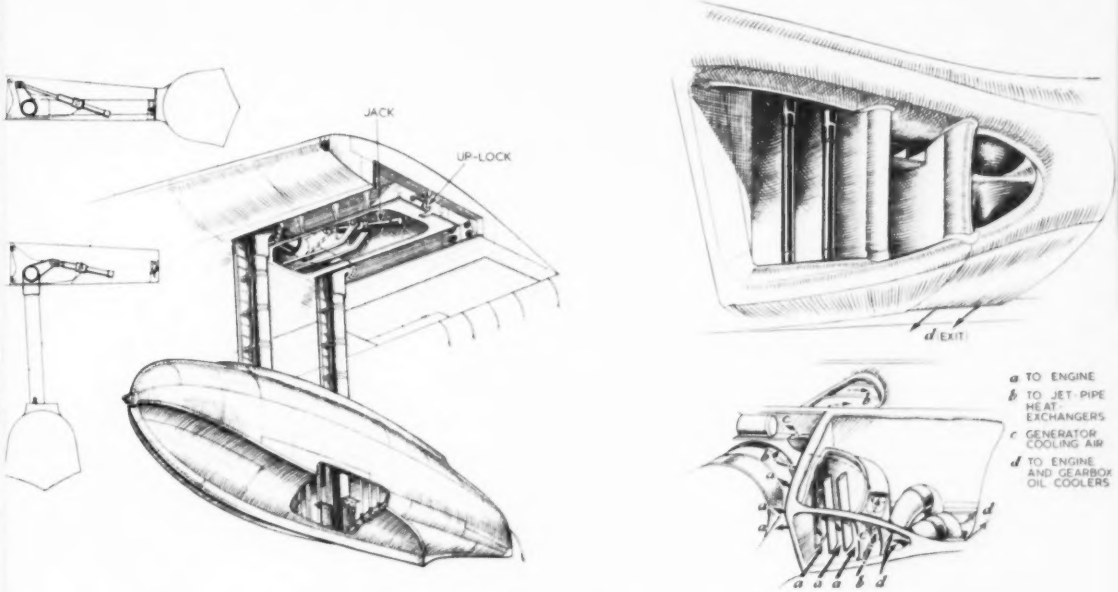
The wing dimensions are not unimpressive: the centre-section span is 27ft, whilst each inner wing is 40ft 3in in length, and each outer panel 51ft. Thus the true wing-span is 209ft 6in, but the total span over the raised tip floats is 219ft 6in. Chords are: centre-section, 30ft 9in; inner wings, 30ft inboard tapering to 26ft; and outer panels tapering from 26ft to 12ft 4in at the tip.

Spars have extruded angle booms and plate webs stabilized with vertical Z-extrusions, and inter-spar ribs are in general of Warren-braced form with tubular struts picking up to the inside of top-hat-section contour members, the crowns of which are attached with extruded shear-cleats to multiple Z-section spanwise extruded stringers. In the hull-bridging portion of the centre section, the inter-spar ribs run span-wise parallel to the spars, this being necessitated by the centre-section bridge having to take on its under-surface the pressure differential of the upper-bubble pressurization. The ribs are massive Warren girders with both channel and tubular bracing struts to deep top and bottom beams comprising extruded angle booms and plate webs.

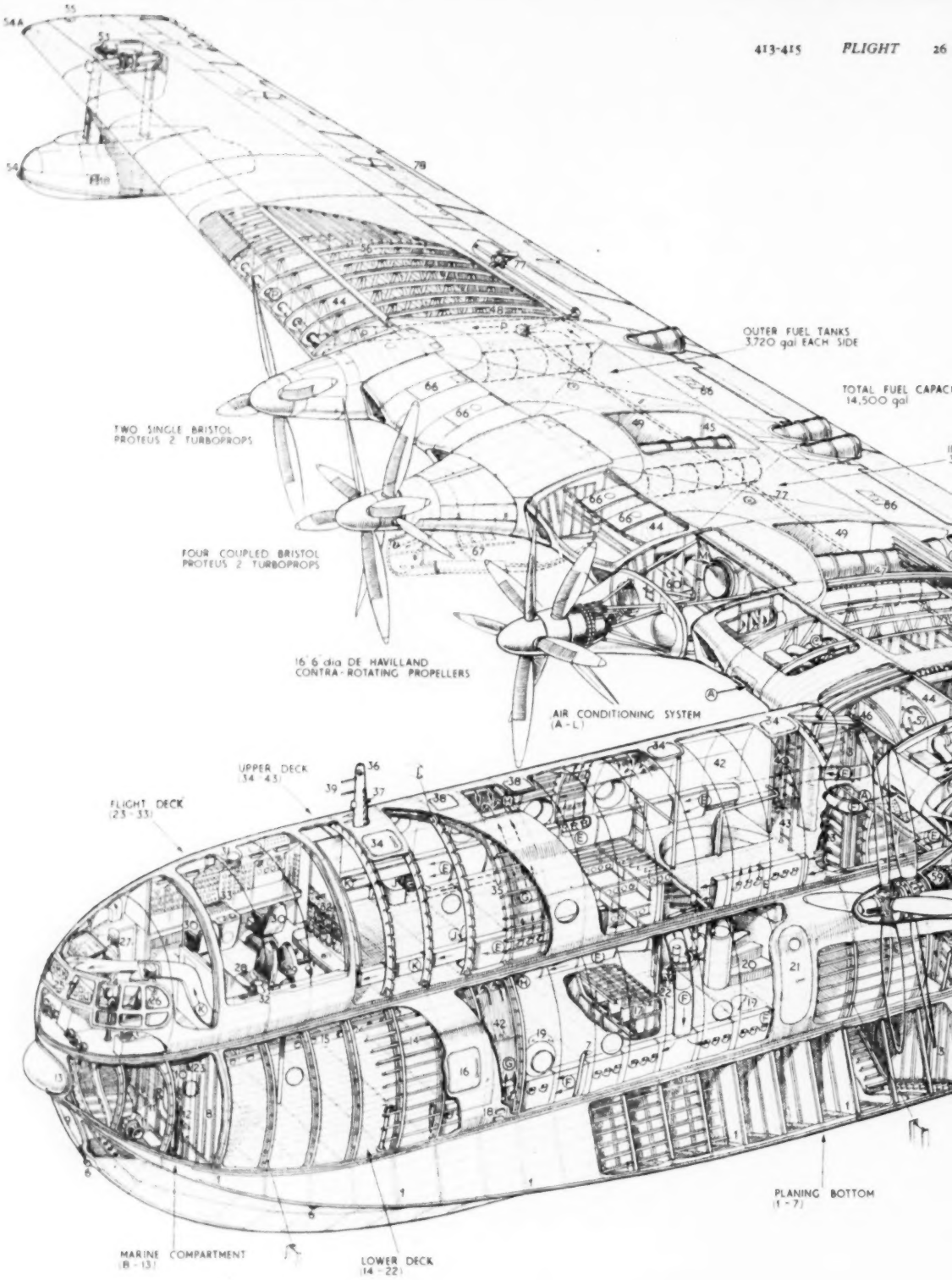
In the inner wings the inter-spar spaces are arranged as four enormous integral tanks with a total capacity of 14,000 Imperial gallons. The end ribs enclosing the tanks are stabilized diaphragms with extruded-angle contour booms through which stringer continuity is given by through-bolted machined fork fittings. Tank internal ribs are Warren-braced, the lower member of each rib comprising an integrally swaged plate roughly one-third the tank depth to serve as slosh baffling. In association with this chordwise baffling at the base of the ribs, spanwise baffle-plates are also used, not only in the lower third of the tank, but also in the upper third; they are attached to the vertical bracing members of the ribs. The external fastenings of the tanks are all fine-limit bolts, so as to



The powered control system is fitted with emergency centralizing jacks on all elevator sections, two aileron sections each side, and to the lower rudder. The two detail sketches show the layout of one of the electro-hydraulic motors and of the final drive to a typical control-surface.

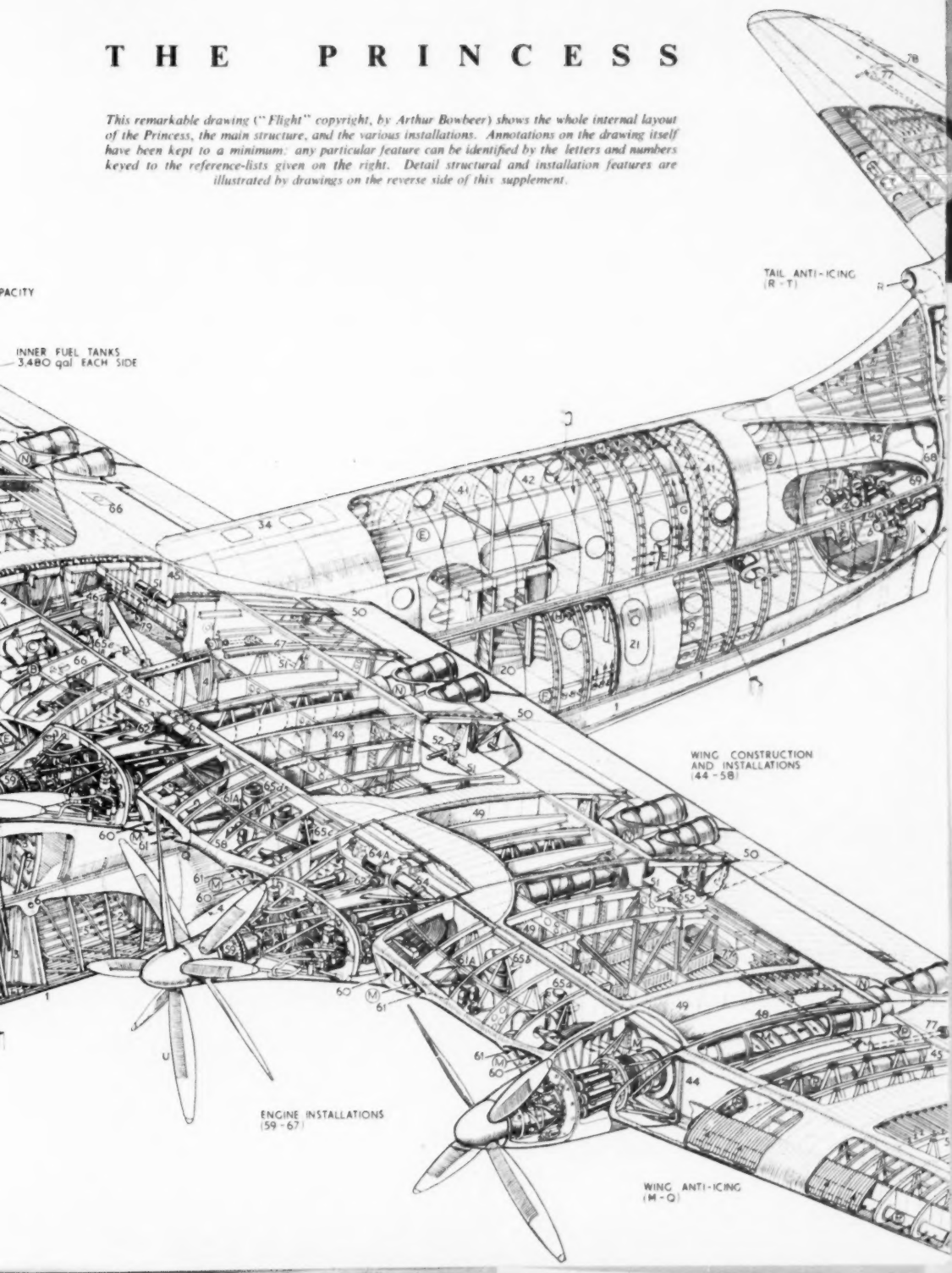


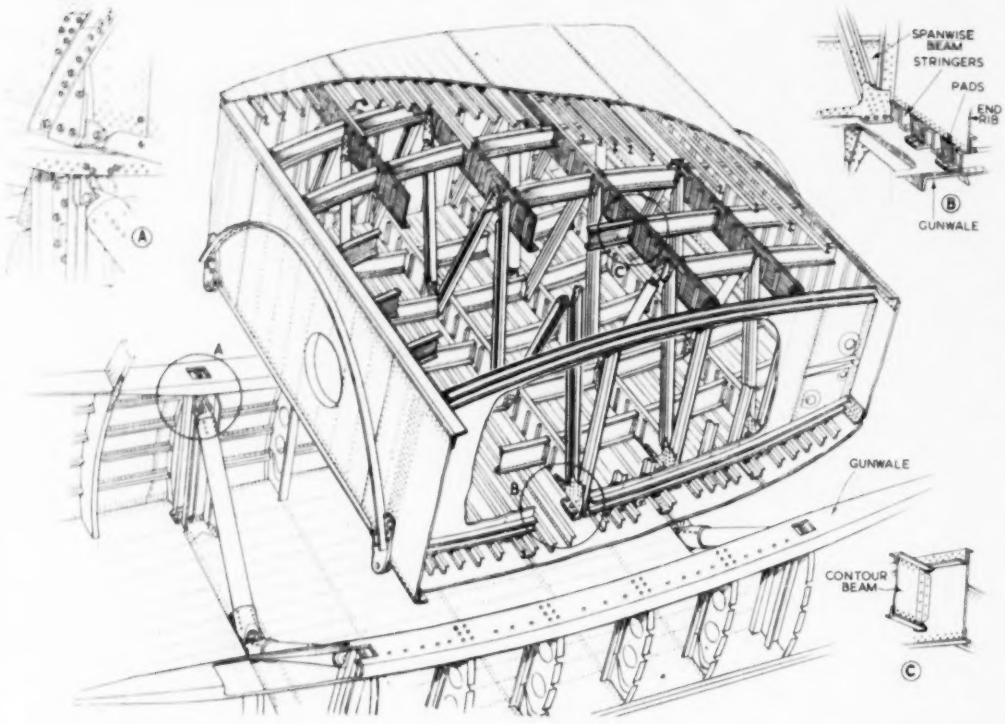
Wing-tip float retraction is eminently simple (left). A peg on the float decking engages with a jack-operated up-lock hook within the wing tip. The leading-edge air intakes (right) are less simple than they appear. The lower sketch shows that, although there is only one beside each engine, the airflow is ducted to four distinct destinations. Within the main engine air duct are two vertical vanes which can be turned through 90 deg to blank off the intake in case of fire. A secondary purpose for these vanes is the sealing of the ram intake in conditions of severe icing, when additional flush intakes—now under development—become operative.


OUTER FUEL TANKS
3,720 gal EACH SIDE
TOTAL FUEL CAPACI
14,500 gal
TWO SINGLE BRISTOL
PROTEUS 2 TURBOPROPS
FOUR COUPLED BRISTOL
PROTEUS 2 TURBOPROPS
16' 6" dia DE HAVILLAND
CONTRA-ROTATING PROPELLERS
AIR CONDITIONING SYSTEM
(A - L)
UPPER DECK
(34 - 43)
FLIGHT DECK
(23 - 33)
PLANING BOTTOM
(1 - 7)
MARINE COMPARTMENT
(8 - 13)
LOWER DECK
(14 - 22)

THE PRINCESS

This remarkable drawing ("Flight" copyright, by Arthur Bowbeer) shows the whole internal layout of the Princess, the main structure, and the various installations. Annotations on the drawing itself have been kept to a minimum: any particular feature can be identified by the letters and numbers keyed to the reference-lists given on the right. Detail structural and installation features are illustrated by drawings on the reverse side of this supplement.





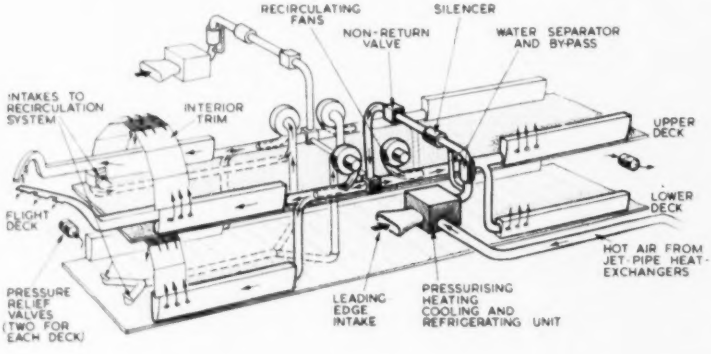
Detail A shows a typical wing/hull main attachment, while at B is depicted the method of attaching the centre-wing lower spanwise booms through the gunwale to the hull frames. Further connection is made from the base of Rib 4 to the gunwale by means of the inter-stringer pads.

reduce the possibility of leaks and, of course, all joints and connections are coated and filleted with the appropriate Bostik compound.

The leading edge of the centre section and inner wings is exceedingly varied in its construction as a result of the wing hull fairing and the intakes and airscrew nacelle fairings. The panelling is, too, broken up by many doors giving access to the mass of equipment housed in the leading edge. In general, however, the panelling is supported on braced ribs (of tube with channel booms) carried off the front spar and united by bridging stringers. The leading edge of the outer wing panels is carried on truss-braced ribs with channel contour booms up to the "nose spar" which forms the rear wall of the de-icing plenum chamber, the nose plating being supported on diaphragm D-formers, through which runs the hot-gas duct.

The trailing edge of the centre-section exists, as such, only outboard of the hull, and in common with that of the inner wing comprises skin panelling carried on truss ribs made up of tubular struts with top-hat contour booms. This applies to the main ribs, between each two of which are a pair of sub-ribs comprising top-hat contour booms shear-cleated to spanwise channels hung from the "brims" of the main-rib booms. The flap-shroud skin plating is supported on diaphragm formers off the main and secondary ribs. A similar structural form applies to the trailing edge of the outer wing panels, with the exception that, toward the wing-tip, the ribs are light pressed diaphragms. At their rear extremities, the ribs are spanned by Z-members carrying brackets which support the extreme trailing edge of the skin panelling to the aileron gap. There is no aileron shroud, and the "balance volume" embraces the whole interior of the trailing-edge structure.

Single-slotted flaps are used on the Princess, divided both physically and for actuation into three, port and starboard. Each



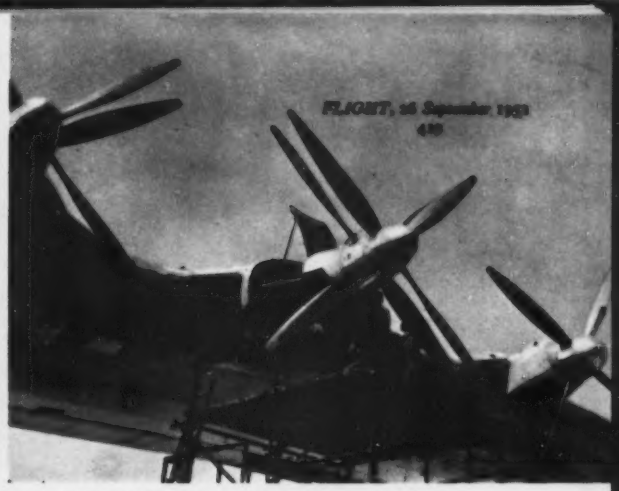
Schematically, the components of the air-conditioning system are here shown in approximately their correct relative positions. For clarity, the recirculation system from the rear cabins has been omitted from the diagram.

Flight, 26 September 1952

SAUNDERS ROE LTD

WORKS AT: EAST COWES, ISLE OF WIGHT · EASTLEIGH, SOUTHAMPTON · BEAUMARIS, ANGLESEY

G-ALUN
The Saunders-Roe "Princess" Flying Boat
is powered by ten Proteus 620
propeller-turbines, installed in
four coupled pairs and
a single unit outboard
in each wing
THE Bristol AEROPLANE COMPANY LIMITED ENGLAND



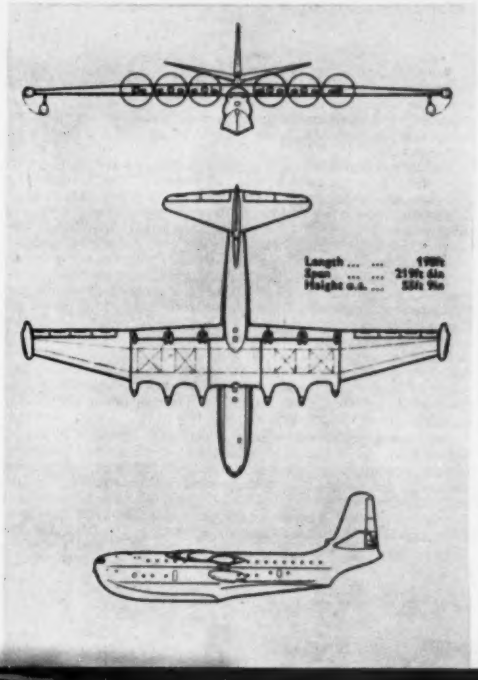
Looking aft along almost the full length of the lower deck. The spiral staircases lead to the upper deck, and the manholes give access to the bilges. (Right) The lower cowlings of the engine nacelles are hinged from the front spar and open downwards to form sturdy maintenance platforms. The airscrews—both single and contra-rotating are 16ft 6in in diameter—are the work of the de Havilland Propeller Company.

The Princess . . .

flap surface is swung on paired links, the geometry of which is such that a slight rearward movement of the surface accompanies the angular deflection. The flaps are skinned on pressed diaphragm ribs in conjunction with raked spars having extruded angle booms and plate webs. Aileron area on each side is divided physically and for actuation into four surfaces. Each is structurally similar in the use of a leading edge spar employing folded angle booms and plate web, the pressed diaphragm ribs extending back to a channel trailing-edge member which forms the mounting for the servo tabs.

The power installation comprises ten Bristol Proteus 2 turbo-props arranged as four coupled and two single units to provide six thrust stations. At these stations the thrust is imposed by de Havilland airscrews, all of 16ft 6in diameter, and all fitted with solid duralumin blades. Whereas the single outboard engines drive single airscrews, however, the four sets of coupled engines each drive contra-rotating airscrews; thus in the event of failure of one engine of a coupled unit, the remaining live half would continue to drive the airscrew. The de Havilland Propeller Co., Ltd., have put a great deal of work into the development of the Princess airscrews and an Ambassador was used as a convenient test bed for flight trials of the (single) airscrews.

The coupled engine units are each mounted to the wing by a



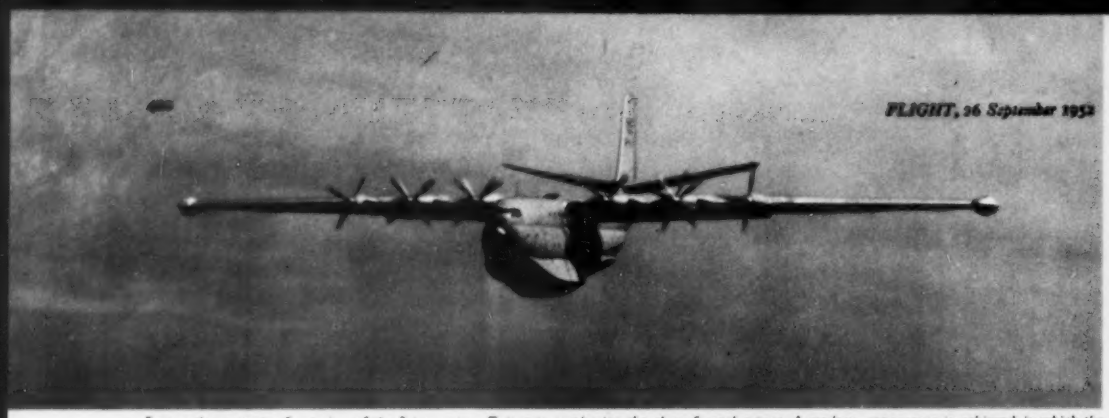
The long jet-pipes, enclosed in shrouds, pass through both main-spar webs. Between the spars they are flanked by the bulkheads of the integral fuel tanks.

steel-tube truss structure anchored to the front spar at four points with forged steel fittings through-bolted to steel "corner-castings" inside the integral tanks. The side struts of the mounting are vee-d to terminate in machined spigots registering in holes in the main mounting ring of each individual engine; thus the side vees take only shear loads. The top tubes rake inward to pick up the engine rings just outboard of top dead centre, and are complemented by two bottom tubes rising to their anchorages on the rings at respectively 135 and 225 deg each; these tubes take thrust. Yaw loads are taken by top and bottom diagonal tubes extending across from the main pick-up points on one side to just inboard of the other engine. From the forward terminals of the shear and thrust struts a compound triangulation of tubes extend forward to pick up on the contra-rotation gear casing.

The single engines are carried on an entirely conventional tubular ring mounting supported by triangulated trusses of steel tube anchored at four main attachment points.

The jet tail-pipes are bellows-jointed at their forward ends, and at the rear are supported (through the enclosing shroud) on rollers just abaft the rear spar, so catering for axial expansion movement. Abaft this, the shrouds are cut diagonally to conform to the wing trailing edge contour, whereas the pipes proper extend unbroken to the final orifice. In side elevation, the tail-pipe axis is parallel to the wing-chord line (the incidence is 2 deg relative to the thrust axis), but abaft the roller support the tail-pipe is inclined upwards 8½ deg relative to its main run. In plan, the pipes converge at a vertex angle of 3 deg throughout their length.

From the unifying and reduction gearbox of the coupled



Even a three-quarter-front view of the Princess is sufficient to emphasize the clean frontal aspect. A modern appearance is achieved, in which the retracted wing-tip floats—suggestive of tip-tanks on a military aircraft—and pronounced tailplane dihedral play a part.

The Princess . . .

engines a central torque-shaft takes drive back to an accessories gearbox mounted on the front spar between the jet pipes, and a cross-shaft from each inboard gearbox port and starboard is taken to the compound blower and air conditioning unit mounted in the leading edge between the inboard nacelles and the hull.

The powered control system designed for the Princess is most unusual, although essentially simple. From the pilot's controls, torque shafts run to transmitter units which have the function of supplying artificial feel proportionate to deflection of the surfaces, but monitored by air speed through the medium of a pitot system. From the transmitter units, cables run to torque-shaft input linkages with the power packs, all of which are housed in the pressurized hull, and so operate in optimum conditions. The power packs are Boulton Paul units, variants of the well-established gun-turret actuators, but in this instance are driven by especially-designed B.T.H. motors. Output from the power packs is by torque shafting serving the indirect-worm screwjacks which directly actuate the control surfaces. The servo units of the Smiths electric autopilot are tied-in to the power packs.

Duplication for safety is provided in an unusual form, in that the control surfaces are divided into individually driven units, some of which are provided with a "trailing" system. For example, each aileron is divided into four sections, two of which can be "trailed"; the elevators are divided into four units, all of which can be trailed, whilst the rudder is divided into three units, one of which can be trailed. The port and starboard ailerons are actuated by port and starboard power packs and, if one power pack should fail, sufficient rolling moment is available through the opposite aileron (in conjunction with the rudder) even in the low-speed-landing case.

If one of the aileron power packs should fail, the "trail" system ensures that the two centre units of the aileron are brought by means of the auxiliary control jacks to the median (no drag) position. The inboard and outboard surfaces are simultaneously auto-locked in the failed position by a clutch in the power pack and, as stated, sufficient control is available with the remaining aileron and rudder to overcome the drag and rolling moment imposed by the failed surfaces. However, handwheels are provided with the power packs so that, if the pilot feels it is warranted in the particular circumstances, he can order one of the crew manually to wind the locked failed surfaces to the trailing position.

As for the ailerons, so for the rudder, except that the two lower surfaces are operated by one power pack, and the lowest has a trail jack; the top surface has its own power pack. Thus, only one-third of the rudder can lock failed in a deflected condition, and the resulting yawing moment can be overcome by the remaining two-thirds of the rudder area. All the elevator surfaces trail, and two power packs serve them, one for the outboard, and the other for the inboard surfaces. No mass-balancing is fitted to any of the control surfaces.

Flap actuation is vested in a pair of B.T.H. electric motors mounted in the middle of the centre-section rear-spar, and rated at 3 h.p. at 7,500 r.p.m. to 5½ h.p. at 5,400 r.p.m. Both motors commonly drive a differential, the output of which is taken, port and starboard, through torque shafting and bevel boxes (which provide a reduction ratio of 4.62:1) and so outboard through the wing trailing edge to actuate the individual secondary-worm screwjacks which move the separate units of the flap. Each screw jack picks up direct to a trunnion bar spanning the lower portions of the front swing links, and universal joints in the torque shafts coupling the jacks cater for wing flexure and are arranged in conjunction with fixed self-aligning ball bearings. In the cockpit, a Dowty eight-position selector switch initiates flap actuation, and the surfaces can be raised or lowered through their full 44 deg of deflection in approximately 20 sec.

The tip-floats are actuated by a Dowty electro-hydraulic system, the central units of which are power packs mounted in each wing tip and serving double-acting jacks which pick up brackets off the cross torque-tubes spanning the float support tubes. Each assembly is carried in plain bearings in the front and rear spars, and the support struts retract into spanwise wells and carry their own fairing plates. The up-lock is mounted on the end-rib, and the down-lock on the jack pick-up bracket. The floats themselves are flat-topped, so as to mate with the end-rib, and are skinned on stringers supported by former frames and bulkheads.

Air-conditioning. As previously mentioned, the hull is atmosphere-conditioned by two compound units housed in the leading edges of the wing roots. These units, which are nominally rated at an output of 60 lb of air/min at 40,000ft, weigh approximately 860lb each, and comprise in a single installation all the several units (aside from those of control) required to treat the air delivered to the hull. The ram air entrained through each leading-edge intake feeds straight through a Marston air-to-air heat-exchange heater to an intake throttle and so to the inlet eye of a two-stage centrifugal blower. Delivery from the blower passes through a venturi, the sole purpose of which is to govern the intake throttles to the blower *via* a flow control unit. The blower operates at its low-speed ratio up to 22,000ft, whereupon its speed is automatically increased to the high-speed ratio.

From the venturi, pressure air can take various paths: (i) through an air-to-air Marston cooler; (ii) through an air cycle turbine cooler unit or (iii) through a refrigerator by-pass in conjunction with either (i) or (ii) or, alternatively, to spill. On emergence from any one of these flow-paths (except, of course, the spill), the air passes in turn through a water separator and Vokes silencer and so, by way of a Normalair non-return valve, into the hull.

The air serving the air-to-air heater is ducted from the engine tail-pipe shrouds (having entered them through ram intakes outboard of the main intakes) and passes through the shrouds in a helical stream to a collector volute fitted abaft the ducts. Air serving the air-to-air cooler is derived from the main intake. In point of fact, the heater and cooler units are mounted vertically one above the other, but have cross-flows. Flow through the cooler is governed by shutters on the upstream side of an auxiliary extractor fan which supplements the ram effect by causing a reduction of back-pressure.

The cabin conditions are selected and maintained by a Normalair system for pressure and by a Teddington Controls system for humidity and temperature. Delivery from the conditioning units in the wing roots is fed in through the centre section and down to a mixing chamber where it joins with the recirculated air. The latter is induced through Vokes filters by four Airscrew Company centrifugal fans developed to a Saro specification, the proportion of recirculated to new air at the cruising altitude being 2:1. From the mixing chambers the air is fed fore and aft through distributor ducts port and starboard just above deck levels, and passes up through the inter-frame spaces to cornice outlet grills. The mean conditioning datum is a relative humidity of 50 per cent at a cabin dry bulb temperature of 23 deg, but the flexibility of the system is such that control combinations are possible in a relative humidity range of from 70 to 30 per cent in conjunction with cabin d.b. temperatures of from 18 to 29 deg C. The ventilation criterion is normally 3lb of air/person/min.

Anti-icing protection to the outer wings is provided by use of hot air from the jet tail-pipe cooling shrouds (as already described for the cabin heating), the hot air being ducted from the collector volutes to the leading edge distributor manifold, whence it passes over the upper and lower nose skinning through the conventional corrugated plating. The hot air escapes back to the main spar, then flows tipwards to exhaust through the float bay (so keeping the

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The lighting in this view emphasizes the double-bubble hull contours. Note also the Proteus tail-pipes and—partly lowered—the flaps.

The Princess . . .

mechanism warm) and thence to atmosphere *via* the outboard aileron controls.

Tail anti-icing is vested in a pair of Lucas kerosine-burning combustion heaters, each of 400,000 B.T.U. /hr capacity, the common intake for which is a ram orifice in the dorsal fillet to the fin. The heaters are variants of the Lucas film-cooled combustion cans for gas turbines, and are heat exchangers in that the products of combustion are kept separate from the anti-icing airflow, and so contamination with its deleterious corrosion effects is obviated. Fuel supply to the heaters is taken from the main fuel system. The airscrews are de-iced by an electric cyclic system developed by de Havillands. It provides for cyclic switching of 24 seconds "on" and 96 seconds "off," and at any one moment there are four blades per wing "on," the consumption totalling 30 kW.

The Electrical System of the Princess is exceedingly large; larger, perhaps, than on any aircraft ever before built. The total generating capacity is 4 x 39 kW at 120V, plus 2 x 6 kW at 24V. The B.T.H. 39 kW generators are driven respectively by accessory gearboxes on the coupled units, the outboard of which also drive the two 6 kW generators. From the port and starboard generator busbars, feed is given to port and starboard distributor busbars from which the services are taken. The 24V system is basically similar.

The Fuel System is essentially simple, and comprises a pair of fully-submerged booster pumps (Self-Priming Pump and Engineering Co., Ltd.), each of 400 gal/hr nominal capacity in each of the four tanks. The pairs of pumps deliver into a common outlet to the low-pressure cock in the particular engine feed line. Between each l.p. cock and its engine is a flowmeter transmitter; the individual h.p. cocks are, of course, mounted on the engines in the normal way. Nominally, the port outboard tank serves the outboard single and outboard coupled engines; the port inboard serves the inboard coupled engines; the starboard inboard tank serves the starboard inboard engines; and the starboard outboard tank serves the outboard coupled and outboard single engines.

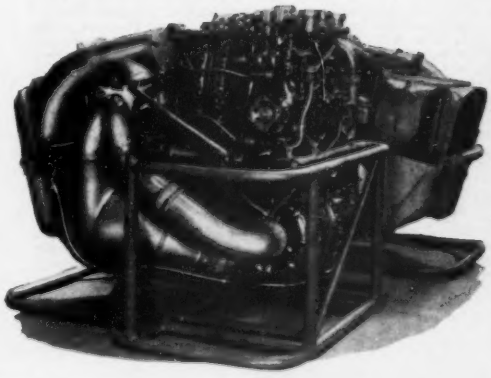
All four tanks are connected by a cross-feed line into which feed the outputs of the transfer pumps which, identical to the booster pumps, are fitted one in each tank. Their delivery into the cross line is governed by a transfer cock in each outlet. Alongside each transfer outlet is a flowmeter transmitter, and in the centre of the cross line is a cross-balance cock. Two fuelling connections are fitted in the port side of the lower deck, beneath the centre-section, and their inlet pipes are bridged by a vent gallery giving into a vent cock through a non-return valve. Each of the inboard fuel tanks is of 3,480 gal capacity, and each of the outboard tanks is of 3,707 gal capacity.

Recent History. So much for the background, concept and physical characteristics of the Princess. To bring our account up to date it remains to log the principal events since the completion of the first of the class—and to add a personal note contributed by the test-pilot.

Her keel was first wetted on August 19th, on the occasion of the signing of the Form 1090. At midnight on the following day she was launched and, after very brief taxying trials on the morning of August 22nd, she was airborne at 12.23 p.m. Geoffrey Tyson, the chief test pilot of Saunders-Roe, had a crew of 11 on board. Dates and durations of flights are: August 22nd, 30 min; August 25th, 1 hr 30 min; August 27th, 3 hr 10 min; August 28th, 1 hr 30 min; Sept. 2nd, 1 hr 35 min; Sept. 5th, 1 hr; total, 9 hr 15 min.

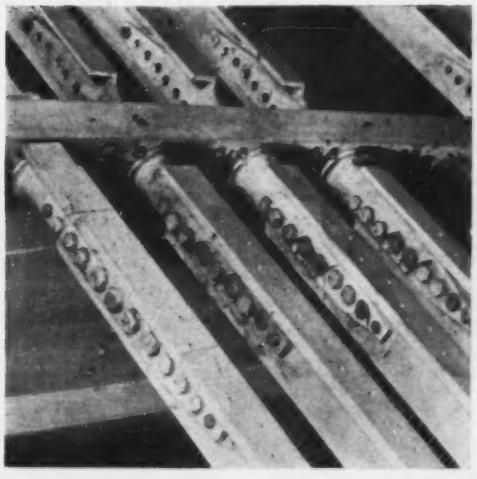
The Princess made her public debut at the Farnborough Display on September 2nd. Concerning that occasion we wrote: "For sheer magnificence the Princess was supreme, and, whatever the future may hold for this incomparable craft (and hope still runs high among those who built her that she may yet accede to her rightful place over the ocean routes), her appearance sent a very special thrill of pride through those who have followed the vicissitudes of her early days." May the hopes of the Saunders-Roe craftsmen be realized.

(*Pilot's impressions, and a list of suppliers appear overleaf*)



(Left) Air for leading-edge de-icing and for the air-conditioning units is collected by volutes at the rear ends of the tail-pipe shrouds. (Lower left) One of the two air-conditioning units, each nominally rated to supply fully treated air at 60 lb/min and weighing 860 lb.

(Below) Machined fork fittings provide stringer-continuity across the end-ribs enclosing the integral tanks in the inner wings.



The Princess . . .

PILOT'S IMPRESSIONS

WE have invited Mr. Tyson—who has carried out all the Princess flying to date—to give his personal impressions of the aircraft. His frank allusions to the minor troubles which beset all early flights (and which are even more to be expected in a machine of such vast size) add weight to his praise of the handling of the aircraft as a whole.

OF course, the early flights were nothing more than shake-down flights—though we hoped to fit in a trip to Farnborough for at least one day—so, quite obviously, my early impressions can't be very concrete.

But from an aerodynamic point of view it was obvious from the start that there was nothing unusual in this aircraft and this applies likewise to the hydrodynamic characteristics. You are probably aware on the first time out it was only 28 minutes from the time I slipped moorings to the time I was airborne and, in fact, the only reason I took as long as this was because the Solent was cluttered up with large ships and I had to do a big circuit before seeing a clear two-mile run ahead of me. I had no intention of doing normal taxying trials, because you learn nothing and probably get frightened. Providing she rode over the hump without swinging and did not start unusual porpoising once she ran into the planing condition, I had every intention of going straight off—subject to all ten engines behaving properly, of course; and this they did.

It had been my intention to stay up two or three hours on the first flight and it was only curtailed because two airscrew translation bearing temperature-gauges gave phoney readings and made it desirable to land.

What is most heartening about the Princess is that it is a one-handed aeroplane. The powered control system in the Princess has been on test in a Mark 5 Sunderland for 2½ years, and in the light of that experience we had chosen maximum stick and rudder-bar forces which have relieved the pilot of undue muscular efforts during the most exacting conditions of flight, i.e., take-off and approach to land.

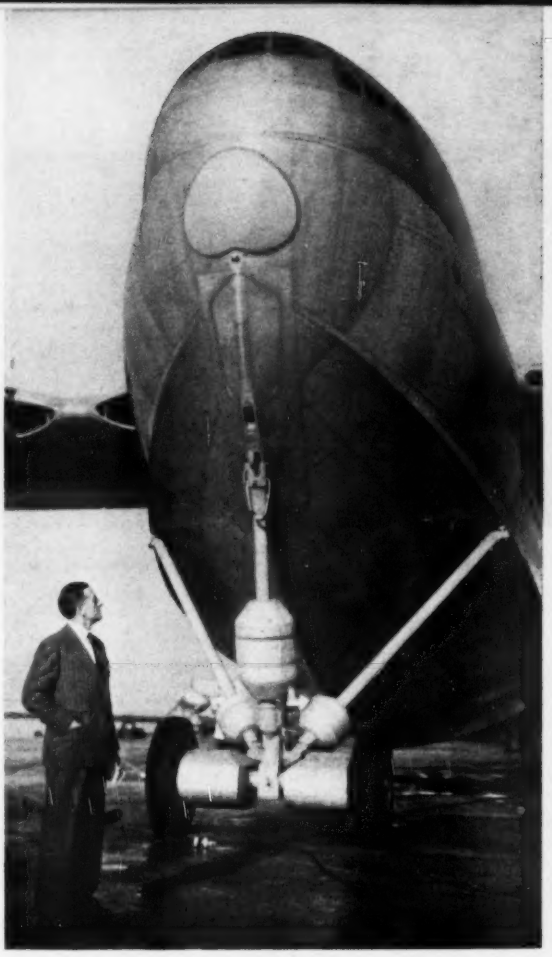
Our maximum stick forces are, in fact, rudder 78 lb, elevator 48 lb and aileron 37 lb; so, for normal movements round about the plus or minus 25 per cent range, the stick and rudder bar forces are quite small. We may have to do small adjustments later on, but until we have flown in every weather condition, etc., we shall make no adjustments. They are quite satisfactory for the immediate future.

In conjunction with the "one handed" flying controls the throttles of the Princess are easily handled by the pilot—a total load of about 12 or 13 lb and a hand-span of only 3½ in. There is no question of having to ask the flight engineer to do any pushing or pulling during take-off or approach.

So far as we can tell at the moment, the controls are very responsive and she is delightful to handle in the air. Of course, we have had plenty of the usual minor troubles. We have been restricted in speed until such time as the ground-resonance test has been carried out and, as a matter of fact, she has been beached for that purpose. I did obtain a maximum permissible speed of 240 kt I.A.S. on two or three of the flights to date without any feelings of discomfort.

After having made our initial flight on August 22nd, during the next week we completed three more flights for a total of 6 hr 10 min. We then decided that since the aeroplane was in one piece and functioning well it would fit in with our plans to visit Farnborough on the V.I.P. day, September 2nd.

The aircraft is now beached for inspections and the resonance tests and we expect to be ashore until the first week in October.



Man and machine: Test-pilot Geoffrey Tyson looks up at the towering bows of the Princess as she stands on her beaching-trolley.

CONTRIBUTORS TO ACHIEVEMENT

Among suppliers of components, materials and services for the Princess, as notified by the constructors, are the following firms :—

A.B.C. Motors, Ltd.; Accles and Pollock, Ltd.; Aeronautical Electronic and Engineering Co.; Aircraft Patents, Ltd.; The Airscrew Co., Ltd.; George Angus and Co., Ltd.; Automotive Engineering Co., Ltd.; Aviation Developments, Ltd.; B.B. Chemical Co., Ltd.; Bakelite, Ltd.; Beard and Fitch; James Booth and Co., Ltd.; Boulton Paul Aircraft, Ltd.; Bristol Aircraft Co., Ltd.; British Electric Resistance Co., Ltd.; British, Foreign and Colonial Automatic Lighting Control Co.; British Insulated Callender's Cables, Ltd.; British N.S.F. Co., Ltd.; British Ropes, Ltd.; British Rototherm, Ltd.; British Thomson-Houston Co., Ltd.; British Timken, Ltd.; Brown Brothers (Aircraft), Ltd.; Bruntons (Musselburgh), Ltd.

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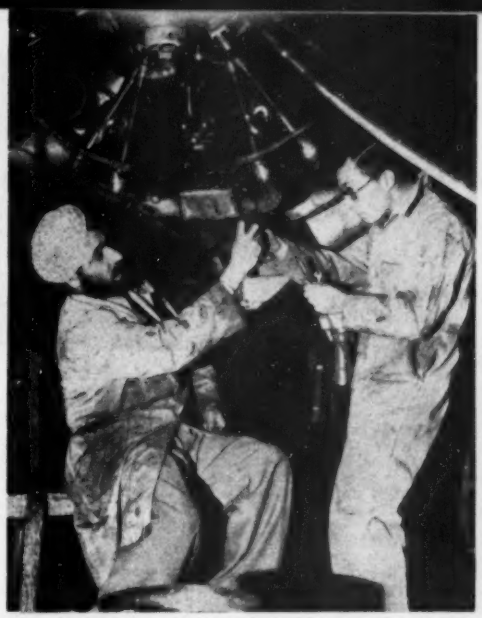
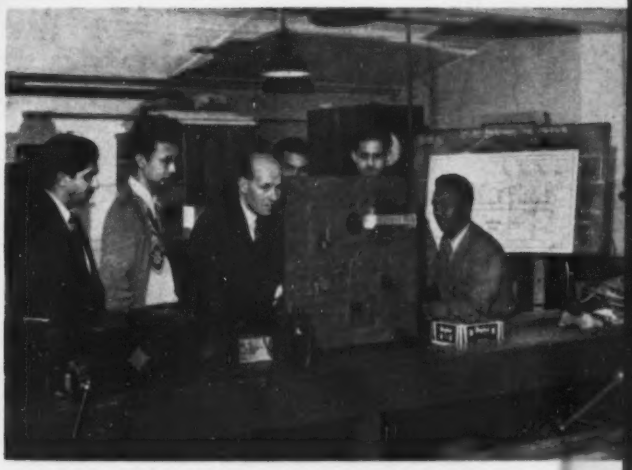
J. J. Habershon and Sons, Ltd.; Hairlok Co., Ltd.; Halex, Ltd.; Hall and Hall, Ltd.; Harley Aircraft Landing Lamps; Hellerman Electric, Ltd.; High Duty Alloys, Ltd.; High Pressure Components, Ltd.; E. H. Hill, Ltd.; Hoffman Manufacturing Co., Ltd.; Henry Hughes and Sons, Ltd.; Imperial Chemical Industries, Ltd.; Samuel Jones and Co., Ltd.; E. and E. Kaye, Ltd.; Kelvin and Hughes, Ltd.; Kent Alloys, Ltd.; King Aircraft Corporation, Ltd.; Langham Thompson and Co., Ltd.; Lasso Products, Ltd.; Lightning Fasteners, Ltd.; Joseph Lucas, Ltd.; Magnetic Devices, Ltd.; Manganese Bronze and Brass Co., Ltd.; Marconi's Wireless and Telegraph Co., Ltd.; Marston Excelsior, Ltd.; E. W. Matthews, Ltd.; Metalastik, Ltd.; Micanite and Insulators Co., Ltd.; Midland Aeroquipment, Ltd.

Negretti and Zambra, Ltd.; Normalair, Ltd.; Northern Aluminium Co., Ltd.; Omes, Ltd.; Pirelli-General Cable Works, Ltd.; Plessey Co., Ltd.; Pytram, Ltd.; Ransome and Marles Bearing Co., Ltd.; Reynolds Light Alloys, Ltd.; Rotax, Ltd.; Rubbaglass, Ltd.; George Salter and Co., Ltd.; Sangamo Weston, Ltd.; Saunders Valve Co., Ltd.; Sciaky Electric Welding Machine, Ltd.; Self-Priming Pump and Engineering Co., Ltd.; Siebe Gorman and Co., Ltd.; Silentbloc, Ltd.; Skefko Ball Bearing Co., Ltd.; Smiths Aircraft Instruments, Ltd.; Sperry Gyroscope Co., Ltd.; Standard Telephones and Cables, Ltd.; J. Stone and Co., Ltd.; Super Oil Seals and Gaskets, Ltd.; Tecalemit, Ltd.; Teleflex Products, Ltd.; Triplex Safety Glass Co., Ltd.; Tufnol, Ltd.; Ultra Electric, Ltd.; Vickers-Armstrongs, Ltd.; Vokes, Ltd.; Western Manufacturing Estate, Ltd.; Wilmot Breeden, Ltd.; John Wright and Co., Ltd.





Students of many races have been trained in England by A.S.T., who are now extending their scope to secondary education in Pakistan. In the firm's workshops at Hamble are shown (left) engine maintenance by an English student and an Indian from East Africa, and (right) students from India, Aden and Hongkong working on a marine radar unit.

Pre-Service Schools in Pakistan

Air Service Training, Ltd., Inaugurate a New Educational Scheme

FOR many years Air Service Training, Ltd., have provided comprehensive training facilities at Hamble for aircrew and ground technicians, and a notable feature of the courses has always been the large number of overseas countries represented among the students. Many young men from Pakistan, in particular, have received instruction there, and since 1949 the firm has operated Royal Pakistan Air Force training units in that country.

This long-standing co-operation between the Government of Pakistan and A.S.T. has now proved the foundation for a recently signed contract, of wide significance to the future of Pakistan education. The British firm is to establish in Pakistan two new schools which will give education up to a high standard to boys aged between 11 and 17 intending to enter the military forces—particularly the R.P.A.F.—or the civil service of that country.

The service tradition of Pakistan—and, indeed, of the complete Indian sub-continent—has long been an army one, and only recently has the importance of the R.P.A.F. as a separate vital service, and not as an army ancillary, been appreciated. That the major problem in building up the force was the supply, education and training of suitable air-minded youths for service as technicians and general duties officers, was realized by A. V-M. R. L. R. Atcherley, C.B., C.B.E., A.F.C., during his tour of duty as Commander-in-Chief of the R.P.A.F. While Cranwell and Halton were assured of suitable entrants from the various technical, grammar and public schools in this country, there was no comparative system of schooling in Pakistan.

To discuss this problem a meeting was held in October, 1950, at the office of the High Commissioner for Pakistan, London, under the chairmanship of A. V-M. Atcherley. Present were the Secretary of the Pakistan Ministry of Defence, the Financial Adviser to the High Commissioner, the Director of Educational Services, Air Ministry, and two directors of Air Service Training, Ltd. At this time A.S.T. were managing two R.P.A.F. training establishments in Pakistan, and possessed considerable experience in the training of personnel for home and overseas air forces.

Establishment of two new schools in Pakistan was suggested at the meeting, following which G/C. R. J. F. Barton, then managing director of A.S.T., invited Mr. D. Crichton-Miller (headmaster of Fettes College) and Mr. George A. Riding (former headmaster of Aldenham School) to investigate the possibilities and difficulties of this project on the spot. The two experts accordingly visited Navy, Army and Air Force training schools and colleges, and consulted education officials. In March, 1951, they reported their findings, on behalf of A.S.T., to Mr. Liaquat Ali Khan, Pakistan's then Prime Minister.

The recommendations of the report were accepted and are now being implemented. Two schools are to be established: a pre-cadet school for 250 boys from 11 to 17; and a pre-apprentice school for 450 boys from 11 to 15. Most boys from the former school will proceed as officer-cadets to Risalpur, and those from the latter will become apprentice technicians at Korangi Creek, Karachi (the A.S.T.-managed R.P.A.F. apprentice school).

The aim of the two establishments is to give basic education and character-training, with only a slight bias towards vocational needs, and thus they will be open not only to intending R.P.A.F. entrants but also to those intending to enter the Pakistani Army, Navy, or the Civil Service. The two schools are at Sargodha and Lower Topa respectively, and, known as "Public Service Schools," they will eventually be united to comprise Sargodha College. The college buildings, on the site of the proposed Punjab university college, will adjoin an airfield.

Initially, the principal, the heads of departments and approximately two-thirds of the teaching staff will be British, but the aim is that in not more than ten years' time, as the teaching pattern and tradition of the schools become established, the whole staff will be Pakistani. English will be the medium of instruction throughout the schools, but Urdu will also be taught. The curriculum will be planned so that at the end of the third year boys of both schools will take the matriculation examination of the University of the Province, and, at the end of the fourth year, the overseas Junior Certificate of the Cambridge Local Examination Syndicate, or its equivalent. After six years, the pre-cadets will take the Overseas School Certificate.

It is hoped that the adoption, so far as is possible, of much of the British public school system, coupled with the experience of A.S.T. in aeronautical training, will have valuable results.

MORE COMET COMMENT

AMERICAN interest in the Comet is still running high—as illustrated by a recent issue of *Newsweek*. This magazine devotes its front page to a colour picture of the Series II prototype and two more pages to an article entitled "Will Britain Rule the Jet-transport Air Waves?" It concludes, however, that the American operators will not buy Comets, and quotes the belief that the "overseas jaunts of the airline heads are designed mainly to 'needle' U.S. producers into action." For all that, *Newsweek* describes the Comet as the world's most talked-of and interesting airliner; it has "set a new and lofty mark for the balance of the jet industry to aspire to."

CIVIL AVIATION

I.A.T.A. MEETS

World Airline Parliament Holds its Annual Congress in Geneva

Sir William Hildred, Director-General.

NEARLY 200 delegates—every one a leading figure in his own organization—attended the eighth annual general meeting of the International Air Transport Association, which was held last week at the Palais du Conseil Général at Geneva. Of those present, over 150 were heads or senior executives of I.A.T.A.'s 58 active member-airlines, the remainder being officials of the Association itself or observers sent by other organizations. Sir Miles Thomas and Lord Douglas of Kirtleside headed the delegations of, respectively, B.O.A.C. and B.E.A., and the major overseas operators were represented by personalities of equal status.

Although the importance of such a gathering is clear, its purpose and significance may not be so self-evident. The man whose interests lie outside the realm of commercial air transport might well be forgiven for confusing I.A.T.A. with I.C.A.O., B.I.A.T.A., I.F.I.A.T. or another of the many bodies connected with aviation. To the question "What is I.A.T.A.?" the Association itself gives a crisp and definite answer : "I.A.T.A. is the world air organization. Its 67 members are the airlines which are scheduled to fly passengers and cargo internationally by the governments of some two score different countries. Between them, these companies carry 95 per cent of the world's scheduled air traffic . . . The airlines have created I.A.T.A. as the agency by which their individual systems are co-ordinated into a world-wide public utility network. I.A.T.A. is responsible on their behalf for unifying and simplifying all phases of airline operation—commercial, legal, technical, financial and medical among them. It attempts to reduce to a minimum the obstacles to free and uninterrupted service over all connecting lines, regardless of difference in language, currency, measurement and business practice. As such, I.A.T.A. is a functional and non-political organization."

Each member, regardless of its size, has one vote at the annual meeting. This conference, which has been aptly described as the world parliament of the airlines, has many functions—among them the determination of policy, the election of officers and committees, and the establishment of terms of reference for the traffic conferences (which meet separately). At the traffic conferences, world-wide rate and fare patterns are worked out by the airlines which operate in the areas under discussion. Their decisions must be unanimous—and often unanimity is only reached after several days of dispute. An important example of the far-reaching effect of traffic-conference decisions was the introduction, last May, of cut-rate fares over the North Atlantic.

Swissair, which is celebrating its 21st anniversary, acted as host to last week's meeting. It was thus appropriate that Dr. Walter Berchtold, the company's president, should take office at the opening session as the president of I.A.T.A. for 1952-53, in succession to Sir Miles Thomas. After a series of closed sessions the assembly listened to the annual report of the Association's director-general, Sir William Hilldred, C.B., O.B.E., who has held office since 1946, and is particularly well known in Great Britain as a former Director of Civil Aviation.

The text of Sir William's speech forms a most engrossing review of air transport; it cannot, however, be reproduced here in full, and there follow extracts reported under the main headings.

Accomplishments of I.A.T.A.—They had made a substantial contribution to international goodwill and in addition had strengthened the operations of the Association inside their own community. Having survived the stresses and strains of the tourist-fare discussions, the machinery of co-operation (which they had laboured over many years to perfect) was stronger than ever in the eyes of their members, of their governments and of the public. The committees deserved their thanks: their members had all served conscientiously, not as company spokesmen, but as experts and advisers of the whole industry.

Financial and Legal Matters.—The gross annual turnover of the I.A.T.A. Clearing House, which had increased from $55m in 1947 to $170m last year, was the gauge of its usefulness to members. This rate of increase had been greater than the overall increase in international traffic itself—from which they could infer that inter-line traffic was growing by leaps and bounds. As they met at Geneva, a diplomatic conference in Rome was dealing with what they hoped would be final ratification of the I.C.A.O. Draft Convention on damage caused by foreign aircraft to third parties on the ground. This draft might not be everything which carriers desired, but it seemed a fair compromise; members were asked to do what they could to ensure the ratification of this convention by their own governments. Regarding the carrier's liability to the customer, Sir William said that the proposed revision to the Warsaw Convention, which was drafted by the I.C.A.O. Legal Committee last January, was preferable in many respects to the convention as it now stood, but was deficient in the most important respect of all—in its actual effectiveness. He was apprehensive of anything which, in the next five years, might create a confused situation on liability. If some governments were quick to ratify a new draft, and others slow, there would be a period of uncertainty.

Technical Matters.—The speaker had been able to report last year that the technical people had met the challenge of I.A.T.A.'s first task—that of keeping pace with I.C.A.O. in erecting the new framework of international regulations and facilities necessary for the proper exploitation of air transport services for the world. Now they were well advanced in progress towards the next phase—definition of requirements for further development of the instruments of air transport. As a result of the Copenhagen symposium on airborne radio equipment, they hoped to encourage manufacturers to plan equipment specifically to meet their needs and to get designers to fit them into the aircraft *ab initio*, rather than put them on afterwards as added weight. And what they hoped to do in electronics they hoped to accomplish in other phases of operations. The other Copenhagen discussions (on the subject of approach-and-landing) had shown that operating minima could be lowered and regularity increased—not by any miraculous discoveries but by more skilled integration of the devices and procedures which they already had. I.A.T.A. representatives had attended all the many I.C.A.O. meetings on performance requirements, injecting airline opinion into their formulation and keeping members informed of developments. It was very important for members to consider most seriously the proposed performance requirements as they emerged. The aerodynamic characteristics of high-speed aircraft were not conducive to the slow approach and landing speeds that they would like for all-weather operations. It was imperative that development of approach and landing aids be geared to the ever-increasing exactness of the tasks they were called upon to perform, and that their complexity remained within the human capability of a pilot.

Traffic Matters.—Sir William made some forceful remarks on the subject of traffic conferences, concluding with a plea for one joint and composite conference once a year a few weeks before Christmas. He had attended two since the last annual meeting, and had contemplated with awe the patience of company representatives who would sit for days until an individual fare had been calculated to the last cent. He had also watched the Clearing House experiments by which the fares so elaborately worked out in traffic conferences were being reduced to average rates within certain areas. The results—worked out simply and with a magnificent disregard for the odd cent or penny—seemed to be entirely satisfactory. Whichever viewpoint was right, he asserted, the decision to hold a single annual conference would save $½m per year.

Postal Affairs.—It was hoped that there would be a change in the Universal Postal Union's decision to cut by one-third the rates paid the airlines for the carriage of certain types of foreign mail. The speaker urged operators to resist any pressure upon them to accept these rates earlier than the formal effectiveness date in July next year. Members were furnished with a translation of letters on the subject which passed between I.A.T.A. and the U.P.U.

Government Encroachments.—After outlining some examples of governmental actions inconsistent with the aims of I.A.T.A., Sir William expressed the hope that governments would be tolerant and understanding in the use of their "undoubted rights" to approve or require a modification of a resolution. He hoped they

FARNBOROUGH

S.B.A.C. DISPLAY

1952

Avro Delta Aircraft

Avro Shackleton

Armstrong-Whitworth N.F.11

Boulton Paul Sea Balliol

de Havilland 110

English Electric Canberra

Fairey Firefly

Gloster Meteor

Hawker Hunter

Hawker Sea Hawk

Short S.A.4

Vickers Valiant

Vickers Viscount

Vickers Supermarine Attacker

Vickers Supermarine Swift

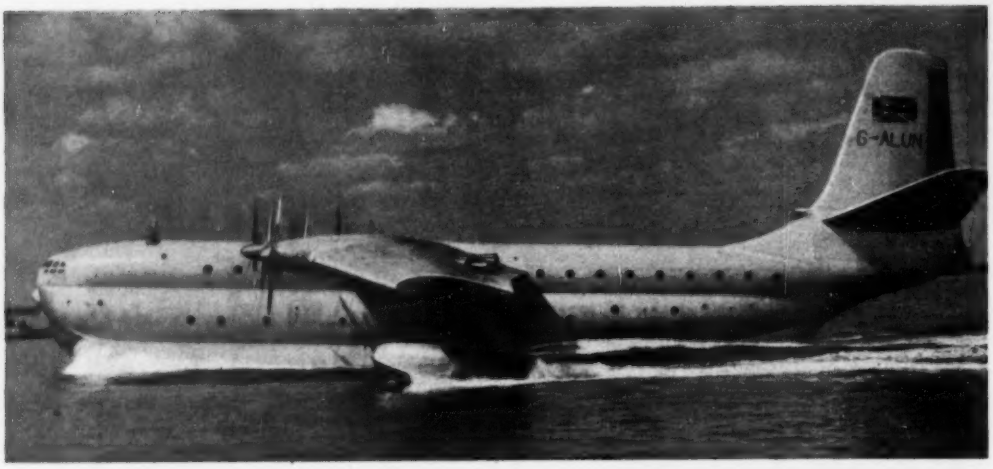
Vickers Supermarine 508

all powered by

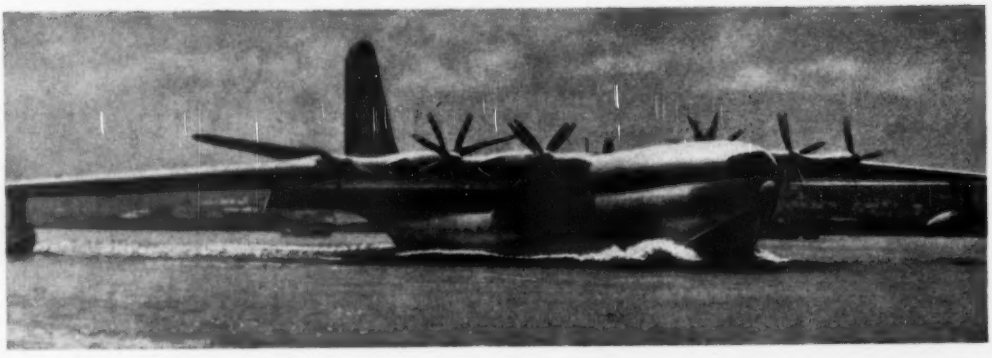
ROLLS-ROYCE

Aero

ENGINES



FABRICS FIT FOR A PRINCESS



Tyglas is used in connection with the heat installation on the wing section of the Princess carrying the coupled Proteus engines. Tyglas is also employed in the laminated radome over the Radar equipment.

Tygan woven fabric has been chosen for the Princess as wall trimming and ceiling in the saloon. It was also selected for the crew's seats and bunks. The fabric offers special opportunities for efficient ventilation.

TYGA

Tyglas and Tygan woven fabrics are manufactured by **Fothergill & Harvey Ltd**

HARVESTER HOUSE PETER STREET MANCHESTER 2

CIVIL AVIATION . . .

would leave rate-recommendations in the hands of a body of men who had done it well for seven years and understood its ramifications to the last cent.

Red Tape.—The efforts of I.A.T.A., in conjunction with I.C.A.O., to reduce the amount of papers and formalities required for international air travel and transport had been increasingly effective during the past year, but they still fell dismally short of the real needs of the situation. "It is a feature of this century that men should suspect men and that petty officials should bristle like diphtheria germs in a child's throat. But there is no consistency in the folly. . . . so oppressive are the obstructions on air transport that the crooks and the smugglers stick to the older forms of transport where the restrictions are less oppressive. Can you beat that?"

Terminal Facilities.—Congestion and lack of facilities at airports constituted one of the gravest problems in passenger handling. Even in places where runways and navigational aids were magnificent, procedures streamlined and officials courteous, traffic could not be handled efficiently "because the terminal was never designed for anything larger than a DC-3 and no provision was made for an easy and inexpensive expansion of existing terminal facilities. . . . I note with consternation that some of the terminals which are so pitifully inadequate for the volume of traffic today were designed and built within the last five years and I am very much afraid that the terminals being designed now to be built within the next few years will also be too small to deal with the even greater expansion of international air travel which we confidently expect." One of the airports with the greatest reputation for smooth and rapid handling of international passengers was still housed in "an agglomeration of Army hutments."

State of the Airline Industry.—The 67 member-companies entitled to representation at the A.G.M. carried between them 82 per cent of all scheduled air traffic and 95 per cent of the scheduled international traffic. The scheduled airlines of the world were now flying 2,500 aircraft of 50 different types and directly employed 250,000 people. Sir William expected that by the end of the year they would have flown 1,700 m kilometres, carrying 45 m passengers. Did the airlines make profits? Operating revenues in 1951 had totalled $1,700 m, and operating costs were probably $150 m less—but this did not mean a $150 m profit. It was a cake which had to feed many hungry mouths, all of whom considered that they were entitled to the entire cake. Taxes took $75 m, and what was left belonged mostly to the large domestic airlines of the world. Yet even among these giants a sense of caution prevailed. A leading member of a large American domestic company had said recently that five good earning years were vital to the airline industry. The difficulties of the international airline were greater, their profit-margins much smaller; there was misgiving lest the mere fact that some profits had been earned should be an encouragement to everybody to come and suck the yolk out of the airlines' nest-egg. The airlines realized that airports and navigation facilities cost a lot of money, and they agreed that for some services they should be charged; at the same time, they wanted the Governments to acknowledge that there were some services for which they should not pay, and that other forms of air-transport should be assessed their fair share of the expenses.

The two important events of 1952—the introduction of tourist services and fast jet service—were in reality two aspects of one phenomenon: the broadening and expansion of the air-travel market. Both indicated that the equipment of the airlines had improved; not only were there modern, comfortable and efficient aircraft, but there were more of them. The success of the tourist experiment had been triumphantly demonstrated by the results of the first three months' operations on the North Atlantic. The increase in traffic over the corresponding period of last year was of the order of 50 per cent; some 150,000 had been carried in both directions. The fact that first-class flights had carried 20 per cent more passengers was even more important, proving that a large number of people still valued comfort and luxury. In Europe, where tourist fares were to be introduced next spring, the airlines faced a more difficult problem. The pattern of the new fares—20-25 per cent cheaper by day, 33-38 per cent cheaper by night—was dictated not only by existing fares but also by the need to compete with surface transport.

Scheduled air-cargo had grown by 330 per cent in five years. The more cargo the airlines carried, the more they learned about its potentialities; the surface had hardly been scratched. As for the helicopter, it was too early to tell whether it would take a significant place in international operations, but it might prove of substantial ancillary importance. If the helicopter were developed to the stage where it became a commercial proposition for carrying traffic in volume, it would surely "divert far more people from surface transport to the air than the jet plane, the atomic plane, or any other kind of plane that needs several square miles of airport to get it into the air."

The scene last week in Geneva's magnificent Palais du Conseil General, the setting for the eighth A.G.M. of the International Air Transport Association. Nearly 200 delegates of some 60 airlines attended—the majority of them, presidents or senior executives.

The Week's Proceedings

The director-general's report covered in general terms every aspect of I.A.T.A.'s activities and interests. More detailed information on executive, financial, medical, traffic and technical matters was put forward in the reports of the respective committees.

Encouragement for the smaller airlines came from Maj.-Gen. C. J. Ventner, of South African Airways, who spoke for the executive committee. He said that traffic conferences might not have gone far enough in granting fare differentials on an equipment basis to the small carriers. The committee's decision, approved by the assembly, to hold traffic conferences annually instead of twice a year would cut down expenses and the irritation of frequent changes of rates and fares. The strength of the committee was increased during the A.G.M. from 13 to 18, the new members being Lord Douglas (B.E.A.), J. R. D. Tata (Air-India International), Sir Leonard Isitt (T.E.A.), G. Obregon (Aviaca), and Prince Pacelli (L.A.I.). It was also announced at Geneva that membership of I.A.T.A. had been approved for five more airlines—two French, one Algerian, and two Far Eastern; the companies concerned are T.A.I., U.A.T., Air Algérie, Garuda Indonesian Airways, and Malayan Airways.

"Significant advances" towards standardizing and simplifying airline accounting practices and the form in which their results are compiled were announced by Mr. R. Lorimer Weir of B.E.A., who presented the report of the financial committee. It was revealed that the Clearing House turnover for 1952 was expected to reach $220 m—an increase of $50 m on the figure for 1951. The financial committee urged members to fight unfair taxes on fuel, lubricants, consumable supplies, income, flight equipment, and sales.

The report of the legal committee was presented by its chairman, Mr. H. J. Friendly, of P.A.W.A.; Sir Harold Whittingham, B.O.A.C., submitted the report of the medical committee.

Reviews of two of the most significant I.A.T.A. gatherings—the traffic conferences at Nice in December, 1951, and at Buenos Aires in May this year—were provided by the airline executives who presided at them. Mr. J. W. S. Brancker, of B.O.A.C., reporting on the Nice conference, said that despite members' widely differing viewpoints on the subject of North Atlantic tourist fares, they had shown "outstanding willingness to compromise and co-operate in getting these very major developments started as soon as possible." Mr. Walter Sternberg, of National Airlines, reported that the Buenos Aires conference had also shown "indications of an improved approach to the sound economics of air transportation. . . . Many of its decisions encouraged one to believe that the member airlines desire to lessen competition . . . and to concentrate on new markets." Both speakers, however, made it clear that the prospect of independent governmental action in the matter of rates and fares represents a serious threat to the work of I.A.T.A.

The success of the Copenhagen discussions on approach and landing (referred to in Sir William Hildred's report) encourage the technical committee to believe that its duty is to bring together

Close-up of the dais during the Geneva conference : on the left, Mr. J. A. MacD. Henderson (I.A.T.A. secretary) chats with Maj. Gen. C. J. Ventner (chairman of the executive committee) while Sir William Hildred confides in M. Gilbert Perier (president of Sabena); on extreme right, Dr. Walter Berchtold (I.A.T.A.'s new president and head of Swissair) consults his notes. Mr. Gordon McGregor of T.C.A. was chosen president for 1953-54.

CIVIL AVIATION . . .

the various specialists concerned in every phase of airline operations. The chairman of the committee, Captain J. C. Kelly-Rogers (Aer Lingus), forecast that greater regularity of services would be a direct result of the Copenhagen conference; I.A.T.A. was now able to recommend considerable lowering of operational minima in bad weather. It was still doubtful, however, if the advantages of developing equipment for fully automatic landings were great enough to offset the cost. The Association was also recommending a revision of licensing procedures for servicing personnel which would "save tens of thousands of dollars annually through more efficient use of mechanical staff . . ." The scheme would be for an "approved organization" to certify to the Government concerned that their tradesmen and specialists were competent to perform their tasks; similarly, qualified line mechanics would hold licences enabling them to inspect and certify aircraft in international transit after maintenance and installation of engines and other accessories. Among other recommendations on technical matters put forward by Captain Kelly-Rogers were : *Performance requirements*—the airlines would examine and criticize the I.C.A.O. proposals both to serve a useful purpose and to ensure self-protection. *Backward-facing seats* should not be made mandatory, being only one factor involved in the question of crash-protection for passengers. Regulations should be confined to a statement of objectives rather than a specification of design details. *Standardization*—I.A.T.A. would co-operate closely with the newly-formed aircraft committee of the International Standards Organization, which had already made encouraging progress. *Approach lighting* —Either the A.L.P.A. or Calvert system should be standardized. Runway lights should be integrated in balance, intensity and layout with the approach lights. Special aids—horizontal bars of light outside and at right angles to the runway—were needed in the touch-down area.

The eighth annual meeting of I.A.T.A. concluded on Friday, September 19th, with the election of officers, the approval of a number of resolutions, one of which expressed the Association's belief that "the fundamental issue ahead of air transportation is the steady development . . . in the interest alike of the public and of the industry as a whole," and its conviction that trends towards unilateral action by Governments were not in the interest of either. The assembly's final action was to elect a president for the year 1953-54—Mr. Gordon McGregor, president of Trans-Canada Air Lines. He will take office at next year's annual meeting, which (at the invitation of T.C.A., backed by the Canadian Government) is to be held in Canada. Delegates expressed their thanks to Dr. Berchtold, this year's president, for the hospitality shown by his company, Swissair, in their role as host.

B.O.A.C.'s PROFIT

AS provisionally announced last April, the 12-month period which ended on March 31st was the first profitable year in the history of B.O.A.C. The story behind the Corporation's progress from a deficit of £4.5 m in 1950-51 to a net profit for 1951-52 of £275,000 is fully told in the report of the chairman and chief executive, Sir Miles Thomas, to the Minister of Civil Aviation. The report, published last Tuesday, also shows that B.O.A.C. retained its splendid safety record during the year. Between July 1948 and June 1952 the Corporation flew no less than 2,000 million passenger-miles without an accident involving fatality or serious injury to passengers.

Two vital factors contributed to the Corporation's success during the year: the average load-factor was increased from 59.7 per cent to 65.7 per cent of a total capacity which had itself been increased by 20 per cent; the second factor was a reduction in the "break-even" load factor—from 75 per cent to 65 per cent. There were, in turn, two main reasons for the lowering of the break-even figure: the cost of each capacity-ton-mile was reduced from 39.5 to 38.8 pence and the average rate of revenue per load-ton-mile was raised from 57.0 to 60.4 pence.

Reviewing the results which had led up to the present encouraging stage, Sir Miles recalled that in March 1948 only six of the total B.O.A.C. fleet of 137 aircraft were suitable for long-range commercial flying. Nine different types were employed, using no fewer than eight maintenance bases. Average block speed of these aircraft was only 186 m.p.h., their average payload capacity was only three tons and their average seating capacity was only 19. By the end of the period under review (the first complete year in which B.O.A.C. had operated with a modern fleet of four-engined pressurized aircraft) the fleet consisted of 72 revenue-earning aircraft of five different types, with an average block speed of 225 m.p.h., a payload of 6.21 tons and seating capacity of 41. Consequently, the hourly output of each aircraft had been raised by about 150 per cent to 1,309 capacity-ton-miles. Only two major maintenance bases were in use.

Staff streamlining was another phase of post-war reconstruction. By March 1951 the Corporation's staff had been reduced by one-third, and by March 1952 the average output per employee, compared with 1947-48, had been raised from 3,790 capacity-ton-miles a year to 11,865. Over the same period the average revenue earned by each employee had gone up from £607 to £2,047

The third phase had been the launching of a sales drive to persuade more people not only to fly, but to fly British. As a result, B.O.A.C.'s traffic had expanded at a faster rate than that achieved by other international air lines. Finally, modern industrial methods of accountancy had been introduced, giving every manager the means to control the costs or revenue for which he was responsible. The result of all these measures, said Sir Miles, had been to convert B.O.A.C. into an organization capable of paying its own way.

The capacity offered and revenue earned on the main B.O.A.C. routes are shown in the following table:—

Route	*Year*	*Capacity-ton-miles*	*Load factor per cent*	*Revenue*
Eastern	1951-52	74,488,000	70.7	£13,662,000
	1950-51	63,212,000	65.8	£10,227,000
African	1951-52	45,474,000	66.6	£7,410,000
	1950-51	31,756,000	69.3	£5,149,000
Western	1951-52	66,763,000	59.6	£11,514,000
	1950-51	62,748,000	48.8	£8,417,000

The general route-pattern to points East remained unaltered, but frequencies were increased and new routeings through Europe and the Middle East were introduced. The closing of the Abadan refinery had caused a severe dislocation of the services and reduction in revenue. Despite the loss of traffic brought about by the withdrawal of the staff of the Anglo-Iranian Oil Company, the Tehran service had been kept up as an essential part of the B.O.A.C. network of British communications to the East, even though a strictly commercial view would have dictated its withdrawal.

Of the total increase of £2.26 m in the total revenue of the African services, the East African routes had been responsible for £1.2 m—a satisfactory increase attributable largely to fare concessions made to Government employees, residents of East Africa and employees of large organizations. Commenting on the present inadequacy of the Nairobi Airport, the report states that this led to B.O.A.C.'s selection of Entebbe as a point of call on the Comet route.

The Western group of routes, which included the services to South America, had operated, on the whole, at a small loss, but revenue had increased by over £3 m and the previous year's £2.6 m deficit had been reduced to £202,000. Over the North Atlantic the Corporation had provided 43,000 seats each way during the year—an increase of 31 per cent. About half the passengers between London and New York had been carried by the Monarch luxury service, which it was planned to maintain at high-frequency during the current year. Progress on the highly competitive route down the east coast of S. America had been encouraging, with an 11 per cent increase over the previous year's load factor of 41 per cent.

The Corporation's passenger-carrying fleet at March 31st, 1952, consisted of 22 Argonauts, 10 Stratocruisers, 10 Constellations

and 20 Hermes; these aircraft had flown a total of 128,124 revenue hours compared with 114,309 in the previous year. Ten Yorks were retained for freighting. Four Hermes had been sold to Airwork, Ltd., on a hire-purchase basis and seven ex-B.S.A.A. Tudors had been sold to the M.C.A. and to a private operator. In addition, the Lancashire Aircraft Corporation had bought 20 Yorks. Argonauts, Hermes and Yorks had operated from their fleet base at London Airport, while the Stratocruiser and Constellation fleet remained based at Filton.

The Corporation had carried 250,173 passengers during the year, an increase of some 25 per cent on the figure for 1950-51. The average distance travelled on scheduled services by each passenger was 3,172 miles. Fares had been increased on many routes to offset rising costs, and the average yield from passenger fares consequently rose from 5.9 pence to 6.11 pence per mile; passenger revenue increased by £5.5 m to £19.7.

Revenue for mail during the year was £8.75 m, compared with £6.2 m for 1950-51. This large increase was accounted for in approximately equal proportions by higher rates and by an increase in the amount of mail carried. The report points out that, at current surcharge rates, air mail is cheap at the price—whereas air travel for passengers is not. If air mail were a commodity, it states, and the Corporation were free to fix a commercial rate for it, postal charges and mail-conveyance rates would be kept as high as the traffic would bear and the proceeds would be applied to reducing the cost of passenger travel. Freight had earned £2.7 m, compared with £2.3 m the year before, the total amount of freight carried being 6,031 tons, some 900 tons more than in 1950-51.

Aden Airways was the only one of B.O.A.C.'s subsidiary airlines to make a profit (£2,338) during the year under review. Bahamas Airways, which incurred a deficit of £101,688, handed over to B.O.A.C. responsibility for operation of services between the Bahamas and neighbouring countries. British West Indian Airways lost £94,102, nearly £200,000 less than the previous year's deficit; the report added that this company's operations were considered to be on a sound basis. During its first six months under B.O.A.C. ownership, Gulf Aviation, which operates three Doves based on Bahrein, lost £11,138; the sum of £14,737 was written off as goodwill and accumulated losses prior to the Corporation's purchase of shares. International Aeradio had "another satisfactory year" and carried forward a small profit.

FIVE-YEAR COMPARISON OF RESULTS—1947-52

	1947-48	1948-49	1949-50	1950-51	1951-52	Percentage Change 1950-51 to 1951-52
I. Output:—						
(a) Capacity flown and offered for sale (ton-miles)	91,342,102	118,422,285	136,447,900	161,670,083	194,536,807	+ 20.3
(b) Aircraft revenue hours flown	163,627	169,434	142,359	125,902	141,429	+ 12.3
(c) Output per aircraft hour (capacity-ton-miles) ... ... (i)	562	701	973	1,297	1,399	+ 7.9
(d) Average aircraft capacity (tons) (i)	3.02	3.72	4.82	5.80	6.21	+ 5.6
(e) Average block-to-block speed (statute miles per hour) (i)	186	189	202	221	225	+ 1.8
II. Staff:—						
(a) Average number employed during year ... ... (ii)	24,101	22,088	19,597	16,547	16,396	— 0.9
(b) Output per employee (c.t.m. per annum)	3,790	5,361	6,963	9,770	11,865	+ 21.4
(c) Operating revenue per employee per annum ... (ii)	£607	£802	£997	£1,466	£2,047	+ 39.6
(d) Capital investment in aircraft per employee ... ... (iii)	£396	£689	£1,457	£1,837	£1,920	+ 4.5
III. Operating Costs:—						
(a) Total operating expenditure...	£21,542,976	£24,962,497	£26,102,495	£27,564,071	£32,164,801	+ 16.7
(b) Direct operating costs (pence per c.t.m.)	33.3	28.1	23.6	22.1	23.1	+ 4.5
(c) Other route costs (pence per c.t.m.)	11.0	10.0	9.7	7.8	7.8	—
(d) Other costs (selling administration, supplies) (pence per c.t.m.)	12.3	11.0	10.2	9.6	7.9	— 17.7
(e) Total operating costs (pence per c.t.m.)	56.6	49.1	43.5	39.5	38.8	— 1.8
IV. Traffic and Revenue:—						
(a) Passengers carried	115,673	142,404	155,557	200,514	250,173	+ 24.8
(b) Freight (tons carried) ...	2,447	3,832	3,968	5,041	6,031	+ 19.2
(c) Mail (tons carried)	2,088	2,149	2,003	2,272	2,895	+ 27.4
(d) Total operating revenue	£14,632,620	£17,717,220	£19,530,584	£24,252,115	£33,567,862	+ 38.4
(e) Load factor carried ... (i)	64.9%	60.5%	55.5%	59.7%	65.7%	—
V. Results:—						
(a) Operating profit (or loss) ...	£6,910,356	£7,248,277	£6,571,911	£3,311,956	£1,403,061	+142.4
(b) Operating revenue as a percentage of operating expenditure	67.9%	71.0%	74.8%	88.0%	104.4%	—
(c) Profit (or loss)	£7,064,961	£7,308,096	£6,991,033	£3,590,321	£1,233,722	+134.4
(d) Surplus (after payment of interest on capital (or deficit) ...	£7,581,831	£7,805,974	£7,791,887	£4,565,428	£274,999	+106.0
(e) Load factor required to break even	115%	100%	90%	75%	65%	—

(i) Based on scheduled services only. (ii) Based on mean monthly number of employees. (iii) Including estimated amounts for hired aircraft. Losses are shown in bold type.

Progress to a profit: tabular comparison of B.O.A.C.'s operating results over the past five years.

The introduction of Comet services, which may be regarded as the Corporation's greatest achievement, took place after the end of the financial year and the initial success of Comet operations is not reflected in the accounts. In the conclusion of his report, however, Sir Miles Thomas notes that the early proving and familiarization flights confirmed the Corporation's view that its decision to order a fleet of Comets was the right one.

"Our forward plans," he declared, "embrace the development of British services circling the world . . . one from London and across Canada to link up at Tokyo with the existing route back to the United Kingdom; and the second from London across the United States to meet the British Commonwealth Pacific Airline service to New Zealand and Australia, and so back to London along the present Kangaroo route.

"It will be our aim to maintain these round-the-world routes in close co-operation with Commonwealth airlines, operating high-speed first-class services with the Avon-Comet, backed by slower tourist services with the Bristol Britannia."

CHARTER NOTES

IN the seven days ended September 21st the independent operators of Britain's merchant air fleet completed 98 commercial flights. These were quite apart from trooping work involving the long-range transportation of about 2,500 military personnel. The drop in business reported last week proved to be only temporary, for 83,000 miles were flown in the week now under review, thus restoring charter activity to the level of a fortnight ago, immediately before the sudden slackening of summer tourist flights.

Last week's flying was almost equally divided among long-range flights and medium-range trips, but there was a very marked increase in cargo activity. Although for some weeks freight activity had been mounting steadily, the estimated figure of 25,200,000 freight ton-miles in the seven days is about twice as high as the figure for only six weeks ago. Correspondingly, passenger traffic has declined, until, in the week under review, it was only 11,500,000 passenger-miles (about 1,045,000 ton-miles), compared with more than twice that volume before the recent reduction in tourist flights. Of last week's distance figure, 60,000 miles is represented by freight flights and 23,000 miles by passenger trips. The volume of cargo carried remained at the new high figure of 420 tons, but passenger traffic was again about 500 people only.

Dakotas, completing about 36,500 miles, were the aircraft in greatest demand last week; Yorks flew about 30,000 miles and Bristol 170s some 16,500 miles. Flying time was almost exactly 500 hours and the probable resultant revenue £34,000.

A.N.A. AND T.A.A.

NO confirmation is available so far of the report, quoted in *Flight* last week, that Australian National Airways may place an order for Vickers Viscounts, although the Trans-Australia Airlines contract for six of these aircraft was announced last May. The latter company is, of course, a Government-formed airline and not, as stated, a private enterprise; despite its title, A.N.A. is a private airline—the largest outside the U.S.A.

CIVIL AVIATION . . .

LUTON'S NEW TOWER

ON Wednesday last, September 24th, Mr. Lennox-Boyd, Minister of Transport and Civil Aviation, was due to perform the formal opening of the new control tower at Luton Airport.

The four-storey structure, which gives a commanding view of the whole airfield and its approaches, has an overall height, to roof level, of 52ft 6in, the height of the control room above ground level being 42ft.

The ground floor will be used as a pilots' report room, the first floor as a meteorological office, and the second as a records office and teleprinter room. On the third floor is an equipment room housing the main V.H.F. R/T., together with batteries giving an automatic stand-by power source in the event of mains failure.

In the control room itself are transmitting and receiving equipment for V.H.F. R/T., as well as a Marconi AD. 200 V.H.F. D/F. installation, together with telephones, crash alarms, and the other usual services, all of which are built into the control officer's desk. The windows are of standard approved design to prevent reflection when night-flying equipment is in use, and, by spraying the ceiling with tinted Pyrok, day glare has been cut down and acoustic insulation provided at the same time.

The V.H.F. R/T. aerials and the wind speed and direction indicators have been erected on a steel mast on the roof. From the control-room floor, exit doors are provided on each side of a concrete balcony which extends right round the tower.

Designed by the Borough Engineer's Department of Luton Corporation, the building was constructed by David Chaston, Ltd., of Hoddesdon, Herts, and the electrical installation was carried out by Scientific Radio and Electrical Services, Ltd., of Luton.

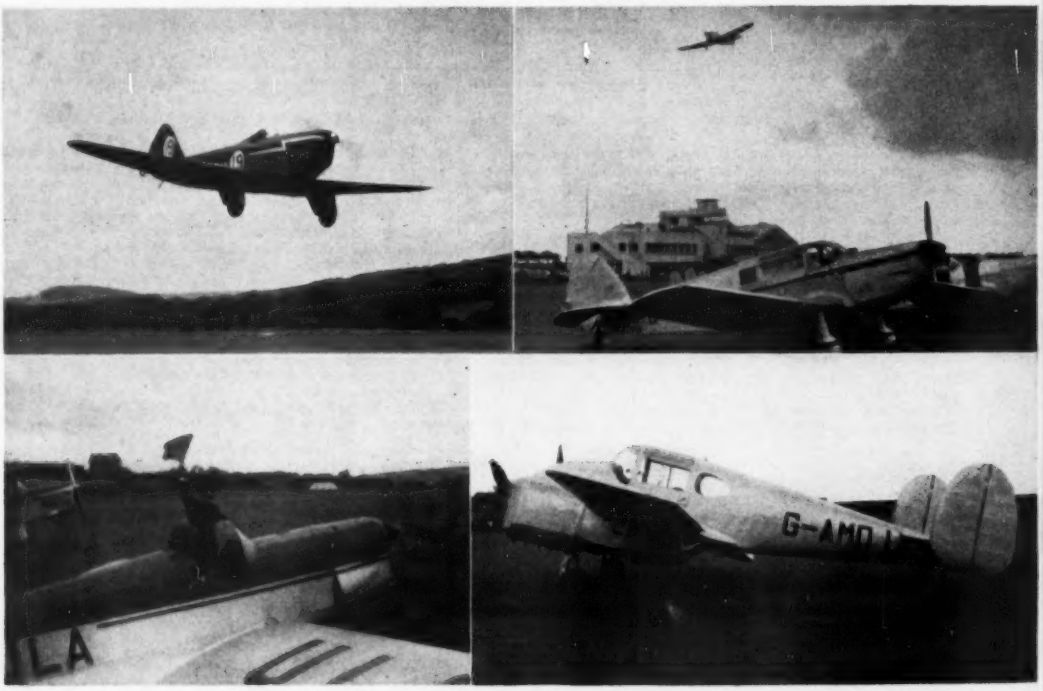
Inside the new tower. As the cliché once beloved of motoring journalists would have it, "all controls fall readily to hand."

The doors and metal windows were supplied by the Crittall Manufacturing Co., Ltd.

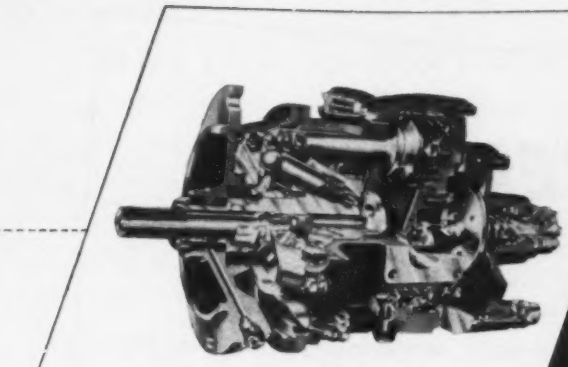
Luton's 373-acre Airport was officially opened in July, 1938, and during the war the area was increased by the acquisition of a further 110 acres. The lengths and direction of the (grass) runways are : N.-S., 4,650ft; N.E.-S.W., 4,350ft; E.S.E.-W.N.W., 5,400ft; E.-W., 3,900ft. Plans have been completed for the erection of additional hangarage, together with a concrete runway and full night-flying facilities.

Companies at present operating from the airport are Percival, English Electric, Napier and Eagle Aviation.

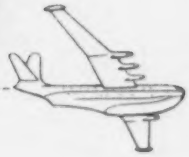
SOUTH OF THE SOUTH DOWNS: A SHOREHAM MISCELLANY

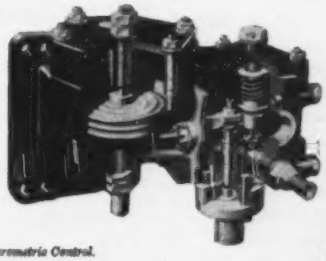


This quartet of photographs was taken at the Southern Aero Club's At Home and air-race meeting at Shoreham, described in last week's issue. The first shows the pretty little Chilton D.W.1.a (40 h.p. Train 4T) being demonstrated by Derek Dempster. Next is an impression of Shoreham's pleasant terminal building, rejuvenated since F. G. Miles, Ltd., lately took over administration of the airfield for the Brighton, Hove and Worthing Airport Committee. The third picture shows Geoffrey Alington, in the Fairey Junior (60 h.p. Walter Mikron) awaiting the fall of the flag in the S.A.C. race, with G. A. Farley's Auster Autocar waiting; Lancing College Chapel is on the skyline. In the fourth photograph is the Miles Aries. In effect an enhanced Gemini, with Blackburn Cirrus Major III engines, it is expected shortly to receive a C. of A. for an a.u.w. of 3,475 lb, thus making it a full four-seater, with luggage in a capacious locker behind the cabin. It was impressively demonstrated by Ian Forbes.



B. Type Pump.

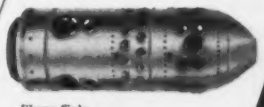




Barometric Control.

Lucas, who supplied fuel and combustion systems for the gas turbine engines of the "Princess", wishes Saunders-Roe Ltd. a successful future for this magnificent new flying boat.

De-icing Heater.



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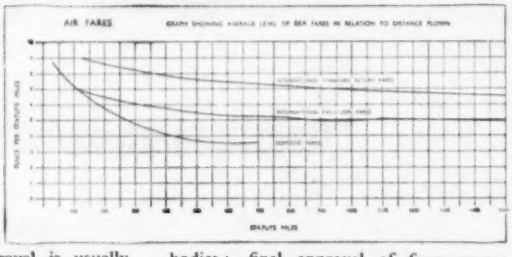
JOSEPH LUCAS (GAS TURBINE EQUIPMENT) LTD., BIRMINGHAM AND BURNLEY

INSIDE **BEA** *No. 10 OF A SERIES*

The right fare What is the operating cost per passenger per mile ? How many passengers can be expected ? What is the extra comfort, convenience and speed of air travel worth to the average traveller ? BEA's problem is to find the answers to these questions and use them to produce fares which make a profit—*and* attract the mass travel market.

International Agreements BEA has its own fare problems. Other airlines operating the same routes may have different ones. In order to avoid a chaotic fares muddle, officers from all interested airlines meet and compare their operating costs. The International Air Transport Association insist that fares on a given route must be uniform —and must be as low as possible. So the fare fixed with IATA's approval is usually founded on the operating cost of the most efficient operator. This gives passengers the greatest benefit.



Cheap, cheaper, cheapest The basic fares approved by IATA are maximum ones. To attract new traffic, operators agree on excursion, off-peak, mid-week and Winter fares. These meet a big demand—and still allow economic operation. Next Summer, " tourist " fares will come into operation on many European routes. These will bring prices even lower, making air travel possible for many more people.

Continental and Domestic Services All IATA Continental fares are first calculated in Sterling. Then they are converted into local currencies. These converted fares must be the exact equivalent of Sterling. IATA members have therefore agreed fixed conversion rates instead of fluctuating bank quotations. On Domestic Services, BEA consults with Regional Advisory Councils and other bodies ; final approval of fares comes from the Ministry of Civil Aviation.

Air Freight The air freight market is still in its infancy—but is growing quickly. More and bigger consignments, the great response to discounts on " Commodity " rates, the more frequent use of air freight by shippers — all these point to enormous expansion of BEA (who already operate Europe's largest air freight network) in the very near future.

BEA

BRITISH EUROPEAN AIRWAYS

SERVICE AVIATION

BATTLE of BRITAIN WEEK

—*ends with R.A.F. At Home Day and the Abbey Thanksgiving Service*

BATTLE OF BRITAIN WEEK, which had started with the London fly-past, was concluded last week-end by R.A.F. At Home Day—when 76 stations, most of them giving flying displays, attracted over 900,000 visitors—and by the Thanksgiving Service in Westminster Abbey.

At most stations the weather was fine and sunny, though a fresh wind kept the thousands of visitors on the move at many of the more exposed places.

A ban had been placed on aerobatics at under 1,500 ft, but programmes suffered little loss in spectacular value. The majority of the stations received visits during the afternoon from touring formations of aircraft, which included Washingtons, Canberras, Lincolns, Mosquitoes, Sunderlands, Meteors and Spitfires. Static shows and other attractions supplemented the flying programmes.

An account of the Abbey Service and displays at typical stations follows.

IN THE ABBEY

THE Service of Thanksgiving for Victory Gained, held in Westminster Abbey on Sunday last, served as a fitting climax to Battle of Britain Week. The Dean of Westminster, the Very Reverand A. C. Don, K.C.V.O., D.D., officiated, and the Queen was represented by Air Chief Marshal the Hon. Sir Ralph Cochrane, G.B.E., K.C.B., A.F.C. Air A.D.C.

A parade numbering over 700 marched in three columns from Wellington Barracks to the Abbey. The first, consisting of Army units, was led by the band of the Royal Regiment of Artillery, behind which came the commander of the parade, G/C. F. E. Rosier, D.S.O., O.B.E., who was a fighter pilot in the Battle of Britain—though he won his D.S.O. in Libya.

The second column, which paraded the Queen's Colour for the R.A.F. in the United Kingdom, consisted of members of the R.A.F., W.R.A.F. and P.M.R.A.F.N.S. It was led by the R.A.F. Central Band.

The third column, marching behind the W.R.A.F. Band, was made up of the R.O.C. and R.A.F.A., the latter carrying their branch banners. Curiously, there were no representatives of the R.Aux.A.F. although it will be remembered that a number of Auxiliary squadrons had taken part in the actual battle.

A Guard of Honour, made up entirely of non-commissioned aircrew, flanked the path leading to the main entrance of the Abbey.

The scene inside the Abbey was very impressive. Boisterous weather outside brought fitful gleams of sunshine through the tall windows as big cumulus clouds swept across the autumn sky, and the angle of the sun was such that the R.A.F. Ensign, as it was borne from the Great West Door to the Sanctuary, was occasionally picked out in brilliant sunshine, giving an almost ethereal effect in such sombre surroundings. On arrival in the Sanctuary the Ensign was taken by the Dean and draped on the altar, the heavily embroidered altar-cloth serving as a perfect foil to the simple colouring of the flag. As the escort moved away a fanfare was sounded followed by a crescendo of drums marking the first bars of the National Anthem.

The first lesson was most appropriately taken from the third chapter of the first book of Maccabees; it included the passage: "How shall we be able, being so few, to fight against so great a multitude and so strong . . . It is no hard matter for many to be shut up in the hands of a few; and with God it is all one, to deliver with a great multitude or a small company."

In his sermon Dr. Don spoke of difficult times ahead and of how unselfishness was the only way out. Quoting St. Matthew, whose day it was, he pointed out that "To give is happier than to get" and for that reason he thought that, despite their trials and tribulations, the people were more joyous during the war. "It was," he said, "true of the few—the happy few—whose names are recorded. Their's was a courage which denied the arithmetic of odds."

At the close of the service the trumpeters sounded the call of the Royal Air Force, the Last Post and the Réveillé, and, as the final notes died away, the Ensign was handed back to the bearers, to be borne in slow time back to the Great West Door.

The Ensign was borne by W/C. C. F. Currant, D.S.O., D.F.C., and escorted by S/L. W. G. G. Duncan Smith, D.S.O., D.F.C., and F/Sgt. K. Eddon.

ABINGDON

ELEVEN THOUSAND people who made the difficult journey to chilly, windswept Abingdon were well rewarded. Despite several cancellations in S/L. Fernand's well-packed programme all events were fast-moving and spectacular. Many of the items were close related to the activities of Abingdon's tenants —No. 1 Overseas Ferry Unit, Transport Command Air Support Flight and the Parachute Training School. The flying show opened with the passing of the "touring" Washingtons, which, for contrast was followed by a display of Tiger Moth aerobatics. Comparative peace was then shattered by the arrival of 12 R.N. Sea Furies and Seafires, which delivered a venomous strafing attack on the airfield; and this ceased just as eight Meteor F. Mk 8s appeared on the skyline for a fly-past. An Oxford then took off for the joy of proving that it was faster (downwind) and livelier than most people thought. Two Vampire F.B.5s followed suit and gave a spirited display within the airfield boundaries. Three Chipmunks then flew over and offered fast-moving, low-level formation and synchronised aerobatics.

Sgt. Plt. Howard, in a Meteor T. Mk 7, gave one of the best performances of the show; specially impressive was a rocket loop which reached 6,000ft.

Five parachutists leapt from a captive balloon at 800 ft, demonstrating five different jumping techniques. A few minutes later the balloon went up again but, to disgorge an acrobat with bared torso and red skirt, a keen gentleman with an ancient bicycle, a witch on a disintegrating broomstick, a rather fearless type clasping crutches, and Neville Duke Mk 2, complete with roller-coaster. Both these parachute demonstrations were really brilliant.

Fly-pasts were then made by a variety of aircraft, and there were further aerobatics.

The penultimate demonstration, certainly the most spectacular, was given by a Hastings which dropped 44 brightly-coloured supply-parachutes; 20 were carried externally and the other 24 within the fuselage.

ANDOVER

MISS VALERIE HOBSON having opened Andover's display by firing a mortar, the programme began with a high-speed run by a Venom, followed by a colourful and skilful exhibition by R.A.F. parachute jumping instructors. Hastings aircraft unloaded Army Paratroopers together with a jeep and a six-pounder gun, and a helicopter demonstration by a Naval Westland Sikorsky S-51 followed.

The Oxford University Air Squadron instructors then flew over in three Chipmunks, and, whilst their formation aerobatics were open to criticism, individually they gave a fine performance. A Spitfire pilot answered requests from the spectators for aerobatics; his manœuvres were faultless and much admired.

A balloon-bursting competition between a Tiger Moth and an Auster brought a humorous relief, but by far the most outstanding feature of the afternoon was the demonstration of air support of ground forces. The Army units taking part were from the 4th Queen's Own Hussars and the Royal Welch Regiment, and the demonstration depicted an armoured formation of tanks temporarily held up in its advance on an enemy strong-point. The tank commander called up an A.O.P. Auster which, flown by Lt. K. Bradley of the Light Aircraft School, gave the spectators a brilliant display of this specialized flying. The commander then asked for saturation bombing by heavy bombers, and this was followed by an individual strong-point attack by rocket-firing Vampires.

BENSON

"SHIPSHAPE and Benson fashion" well describes the programme at this renowned home of photographic reconnaissance.

Prominent in the static displays were all types of aircraft cameras, together with examples of target-briefing models. As an extremely valuable peacetime activity, P.R.U. aircrews are now engaged on photographic surveys for various Government departments. Incidentally, one print of *every* survey photograph taken by the R.A.F. is held in the print library at Benson.

The Station Commander (G/C. L. V. Stickley, O.B.E., D.F.C.) introduced Mr. John Hay, M.P. for the Henley district, who announced the opening of the flying programme. The initial take-off by a pair of Meteors from opposite ends of the same runway was startling, but the item developed peacefully enough with fast runs by the T.Mk 7 and oblique photographic sorties against the public enclosures by the P.R. Mk 10.

Individual demonstrations, formation flying and other well-tried events followed during the afternoon. Meanwhile respectable citizens of all ages were to be seen clambering into statically displayed aircraft.

Seafires and Sea Furies of the Royal Navy arrived in support of an attack on a strong-point by men of the R.A.F. Regiment, who had been landed by a Valetta. This was a noisy

"Flight" Photograph

OVER CAMBRIDGESHIRE: Three Lincolns and two Mk 16 Spitfires from Technical Training Command entertain the crowds at Duxford.

SERVICE AVIATION . . .

success and served to heighten the effect of the sailplane aerobatics which followed.

Other aircraft of interest included an immaculate Viking of the Queen's flight; the prototype PR3 Canberra (VX 181), a visiting B-45 Tornado of the U.S.A.F., and the Valiant—passing by, apparently, on normal business.

DUXFORD

PROCEEDINGS were opened by the "touring" Washingtons and Mosquitoes. A Chipmunk from No. 22 R.F.S., Cambridge, gave a fine display of aerobatics, and next came a first-rate show of tight formation flying by Meteor 8s.

This was followed by an exciting display of individual aerobatics by a Meteor 8 pilot. Two outstanding evolutions were a sustained inverted climb and an outside loop performed in two halves, the latter being particularly impressive. The aircraft was inverted on the last half circuit before his landing approach and the pilot put his wheels *up* ! An Attacker then proceeded to emulate some of the Meteor's antics, with considerable success.

A simulation of an attacking force of fighters being intercepted followed, and the ensuing dog-fight was most convincingly carried out. There was a grand free-for-all at about 6,000ft, between the defending Meteor 8s and the "enemy"—U.S.A.F. F-84s. Next came formation flying by the F-84s.

Four Meteor 8s then performed aerobatics as one—a superlative exhibition of flying. Diving in line astern, they changed into a diamond formation as they climbed into a loop. Slow rolls and stall turns followed, all in the same tight formation.

Next came a businesslike show by an A.W. N.F.11 night-fighter, followed by a dive bombing attack by six Meteor 8s on a defended strong point on the airfield, ground defence being provided by No. 629 L.A.A. Regiment, T.A.

Sixteen Biggin Hill Meteors treated the crowd to formation flying *par excellence*, and a single U.S.A.F. F-86 with longe range tanks took off and performed a number of manœuvres.

Four U.S.A.F. F-84s concluded a fine show with some magnificent aerobatics, during which they several times disappeared into a descending cloud-base.

NORTH WEALD

AT North Weald, three bomber Command Washingtons opened the programme by flying past precisely on time, and they were followed by a formation fly-past of 16 of the station's Meteor 8s. Visiting Chipmunks of Manchester University Air Squadron gave formation displays and an individual demonstration; Bomber Command Lincolns, Canberras and Mosquitoes, touring other "At homes," passed over; and impressive, contrasting performances were given by an Army Auster and a Naval Attacker.

Individual contributions by a Mosquito, a Spitfire and an R.C.A.F. F-86 Sabre followed, and light relief was provided by two Tiger Moths, pitting their wits against free balloons. Three Vampires of 72 Squadron—led by an "exchange scheme" officer, Maj. J. Brown of the U.S. Marine Corps—then demonstrated air drill, and an unbelievably successful attack on the airfield was made by four Meteors. The star turn of the programme then appeared: four U.S.A.F. F-84s from Weathersfield emulated the precision and most of the manœuvres of the famous Skyblazers in a brilliant formation demonstration, culminating in the "bomb-burst" and a four-point low-level crossover with two aircraft inverted. A surprise attack by three Seafires and four Sea Furies from R.N.A.S. Culham preceded a ten-second-delay parachute jump by an R.A.F.V.R officer, and this concluded the flying programme.

ODIHAM

AT Odiham, Hants, the high spots of an admirably run programme were contributed by Meteor 8 pilots—individually and in two crack teams.

The first team, from one of the station's two famous squadrons, staged an effective attack on a fort, and the second put up a superb formation show. Most of their aerobatics were performed either in box or arrowhead formation, often changing from one to the other in mid-evolution. The four aircraft might have been joined by invisible bars—short ones at that—and even when the tightly-knit quartet made an upward roll this impression persisted.

Other aerobatics were contributed by such varied types as a Chipmunk, an Attacker, a Tempest and a sailplane, and the station shared in the various communal fly-pasts. The commentator displayed unsuspected thespian abilities when he told the crowd that two Sabres were diving in to produce a supersonic bang; there was a bang, but it was followed by the appearance of a cloud of smoke on the boundary—and by two fancy-dress Tiger Moths.

A static show and a fun-fair in aid of Service charities were expertly run by station personnel. The new station commander, G/C. J. A. Kent, D.F.C., and the Wing Commander, Flying, W/C. D. Crowley-Milling, D.S.O., D.F.C., have reason to congratulate themselves and all concerned.

TANGMERE

FOR the first time since before the war, the famous fighter station at Tangmere was opened to the public. Occupying it now are units equipped with day fighter Meteors Mk 8 and night fighter Meteors N.F.11. At 3 p.m., three 11s opened up their Derwents, and took off past the crowded enclosure, to execute some high-speed passes, while a Tiger Moth looped and rolled above.

After the "touring" Washingtons had passed over, two Tigers were "scrambled" to intercept an Oxford—the actual interception being accomplished by the Tigers keeping their throttles wide open, and the Oxford pilot closing his, and putting the undercarriage down! Forced down with much firing of blanks and very cartridges, occupants of the Oxford in pirate garb were chased across the airfield by R.A.F. Police in a van.

Some excellent aerobatics were accomplished by an Attacker from Ford, closely followed by the Canberras, and Lincolns, also on "rounds."

Further naval entertainment was provided by two Fireflies, one equipped with RATOG.

Eight Meteor 8s were scrambled to attack three Wellingtons, which were closely followed by three Mosquitoes. The Meteors returned to strafe dummy buildings on the south side.

Delicate hesitation rolls formed part of the show next put up by a single Meteor 8, which preceded an A.T.C. Kirby Cadet and further aerobatics, this time by three Meteor 8s.

The 20 machines in the static park provided a constant source of interest.

WEST MALLING

NO spectacle was more likely to revive memories of the summer of 1940 than the Spitfire which cavorted gracefully in the bright blue skies above West Malling on Saturday afternoon to the delight of the large crowd which had assembled from neighbouring Kentish villages.

West Malling's regular squadrons of Vampire N.F.10s and Meteor N.F.11s had flown over the airfield in tight formation and had then left to visit other stations in the Southern area, and in return the station received visitors from Bassingbourn in the form of three Canberras—one with tip tanks. Bomber Command's representation was completed by formation fly-pasts of Lincolns and Washingtons.

The abilities of No. 500 Squadron (County of Kent), R.Aux.A.F., were exemplified by a noisy and exciting low-level attack by Meteor 8s on targets in the south-east corner of the airfield, but the outstanding items were the two formation-aerobatics teams. S/L. D. de Villiers, C.O. of 500 Squadron (and chief test pilot of D.H. Propellers) having given an excellent exhibition of aerobatics in a Meteor 8, later took off with F/Ls. Sumner and Moreau to thrill the crowd with a masterly display. Their line-astern loop changing to vic formation was, in particular, brilliantly executed. The precision and excellent placing of manœuvres was matched by three of the station's Vampire N.F.10s, which with F/Ls. R. Bowrie, C. C. Smith and F/O. A. Wright up, were, we were told, the first night fighters to display formation aerobatics.

During the afternoon the exhibition inside a hangar had attracted many visitors, while the assorted aircraft in the static display were a source of constant delight to the many small boys loose on the airfield. At the close of the programme F/O. G. B. Bell took up a Meteor N.F.11 to show off its agility and urgent climb.

PILOT PRINCE: Now commissioned in the General Duties branch of the R.A.F.V.R., Prince Nicholas of Yugoslavia recently completed his 15 days' annual training at Fairoaks, Surrey. He is seen here with his instructor, F/L. Bernard Tucker (left).

EXERCISE ARDENT

THE biggest air exercise ever to be held in peace time will take place over the United Kingdom during the first two week-ends in October and in one mid-week phase.

The object of the exercise, which has been given the code name "Ardent," will be to subject the U.K. air defences to intensive operations such as might be experienced in war. Aircraft involved will fly several thousands of sorties to test the defences, and will try out a variety of methods of attack.

All Commands of the Royal Air Force in the U.K. and on the Continent will contribute to the exercise. In addition, Anti-Aircraft Command will participate, and aircraft of the Royal Navy, the U.S.A.F., and other NATO Air Forces will play their part.

New features of this year's exercise are the employment of Canberras and Sabres, and the use of airborne forces. A greater number of aircrew and ground staff will be engaged in this exercise than ever before.

The United Kingdom Air Defences are under the command of Air Marshal Sir Basil Embry, A.O.C-in-C. Fighter Command.

Many R.A.F. Reservists will be assisting during their fortnight's annual training. In addition there are a number of other reservists who have volunteered to help. Volunteers of the R. Aux. A.F. will be on duty at the weekends. Fighter Control Units and the Royal Observer Corps will be deployed at maximum strength during both weekends, and Territorials of A.A. Command will also be at their operational stations.

Photo by courtesy of Saunders-Roe Ltd.

THE FUSELAGE OF THE 'PRINCESS' BEING INSULATED WITH FIBREGLASS SUPERFINE FIBRE

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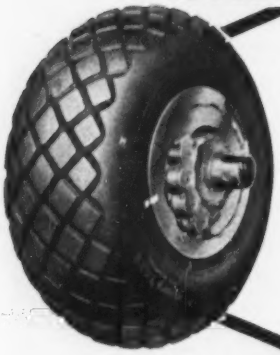
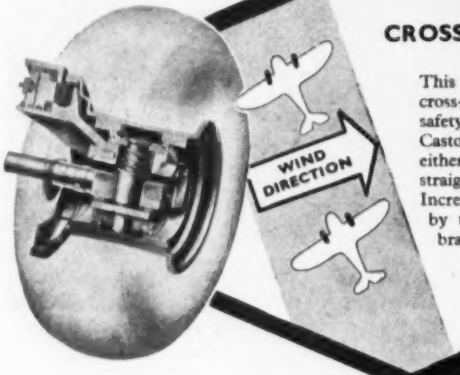
SAFETY ON TOUCHDOWN



GOODYEAR

AIRCRAFT TYRES

Developed through years of research and testing, Goodyear aircraft tyres are built to "take it" on touchdown. Resistant to heat, fatigue and bruising, built to stand up to the impact of weight multiplied by m.p.h., they assure safety at today's high landing speeds. The All-Weather Tread illustrated is one of the variety of aircraft tyres, designed to give maximum reliability under all conditions.

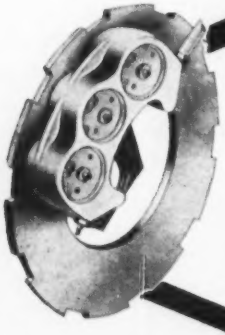


GOODYEAR

CROSS WIND LANDING GEAR

This patented Goodyear device permits cross-wind landings or take-offs in relative safety, without any tendency to ground loop. Castoring wheels permit a yaw of 25° on either side of centre while maintaining a straight course along the runway.

Increased flying safety is further enhanced by the incorporation of the popular disc brake in this revolutionary castoring wheel.



GOODYEAR

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The Disc Brake was first introduced by Goodyear several years ago. Since then the knowledge gained from actual operating experience has been vigorously applied, and to-day, the Goodyear Disc Brake has a reliability unique in this field. They give the pilot real confidence in landing, and sensitive control in every ground manoeuvre. Here again, Goodyear Research and Enterprise are far in the lead.

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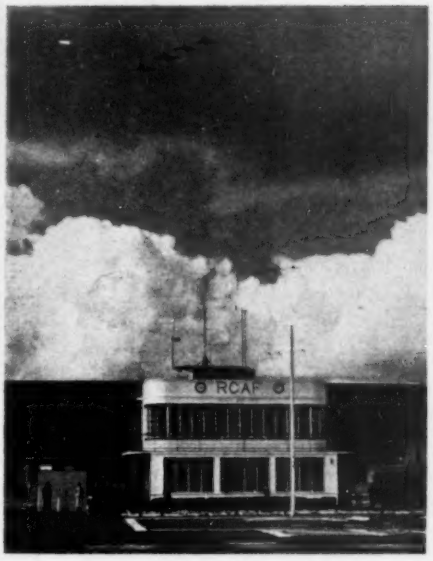
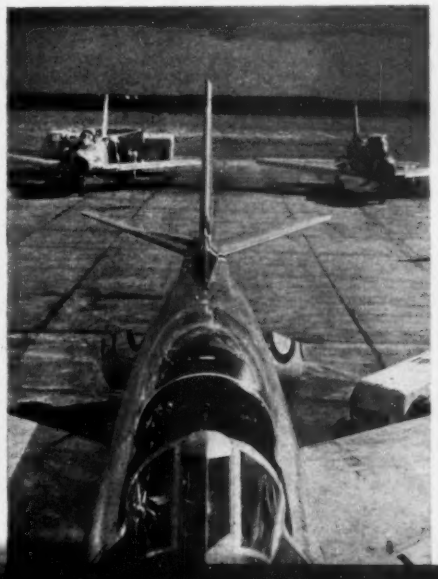


R.C.A.F. Squadrons Nos. 410, 441 and 439 in echelon to starboard as they pass over North Luffenham's control tower.

R.C.A.F. SABRES

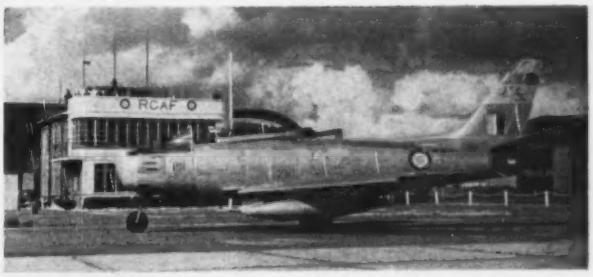
Canadian Squadrons Practise for Battle of Britain Display

Only the dive brakes interrupt the outlines of these Sabres of No. 441 (Silver Fox) Sqn.



Tiger, Silver Fox and Cougar Squadrons fly over their base in perfect boxes of four.

"FLIGHT" Photographs



The Sabres of No. 439 Squadron have a tiger head on the fin and red diamonds on a yellow band on the nose.

(Above) Black and white checks, the mark of No. 43 Squadron in the R.A.F., has been adopted by No. 441 Squadron R.C.A.F.

(Below) The gaily painted R.C.A.F. Sabres make a colourful scene in the late summer sunshine on the North Luffenham tarmac.

SERVICE AVIATION . . .

R.Aux.A.F. Appointment

THE new commanding officer of No. 608 (North Riding) Squadron, R.Aux.A.F., is to be S/L. G. A. Martin, D.F.C., A.F.C., who is a regular R.A.F. officer. He was first posted to No. 608 last June and will replace S/L. F. A. Robinson, D.F.C.

S/L. Martin was awarded his D.F.C. in 1944, while with No. 73 Squadron, after completing many night fighter and intruder patrols. He destroyed one enemy aircraft in the air and at least eight on the ground. In January, 1945, he was awarded a Bar to his D.F.C. for having continued to display "exemplary leadership, skill and daring" in low-level ground attacks in which he destroyed 31 locomotives, bringing his total bag to 55. Noting that he had also destroyed 12 aircraft and much transport on the ground, as well as two aircraft in the air, the citation stated that he had continued to show the utmost skill and courage both in the air and on the ground. His A.F.C. award was made in June, 1949.

Destroyer Command for R.N. Pilot

AFTER 16 years in Naval aviation, Capt. P. D. Gick, O.B.E., D.S.C. and Bar, R.N., is to take command of H.M.S. *Daring*, one of the latest class of destroyers.

Capt. Gick, who has recently been in charge of air officer appointments on the staff of the Second Sea Lord, trained as a pilot in 1936 and in the early part of the war was a torpedo pilot in Swordfish aircraft. He took part in the attack on the *Bismarck* from H.M.S. *Illustrious* and also in operations from the famous *Ark Royal* in the Mediterranean, and, after the latter ship had been sunk, commanded a squadron engaged on night anti-submarine duties, operating from the Western Desert. For these services he was awarded the D.S.C. and Bar. It is said that his favourite flying rig included a bowler hat and monocle.

In 1944 he became Air Co-ordinator on the staff of Admiral Sir Cecil H. J. Harcourt in the Far East. When the war there came to an end he took command of a Chinese junk, disguised his crew as native fishermen and carried out a successful campaign against pirate vessels infesting the area.

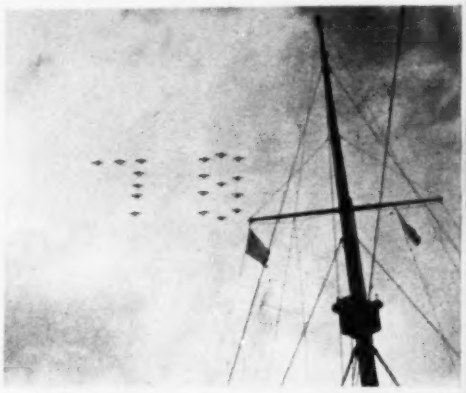
R.A.A.F. Survey

NEXT month No. 87 Photographic Reconnaissance Squadron, R.A.A.F., is to send a detachment to Port Moresby to carry out surveys and mapping photography in New Britain and New Guinea.

The squadron has already completed a series of photographic surveys of parts of Australia and the Fiji islands. This Australian survey covered about 300 square miles of territory in western Queensland, the Northern Territory and northern New South Wales.

The area photographed included the now widely known Rum Jungle uranium field and possible bauxite deposits in Arnhem Land. The other operation was a survey of the Fijian Islands carried out at the request of the Government of Fiji.

NUMERICAL WELCOME: When the Australian 78th Fighter Wing arrived by sea at Malta recently, Nos. 73 and 105 Squadrons of the Royal Air Force, which are stationed there, put up a "78" formation over the ship to welcome the new arrivals.



Rapier Trophy

TO emphasize his contention that bombing should be thought of in terms of a rapier, and not as a bludgeon, Air Chief Marshal Sir Hugh Pughe Lloyd, A.O.C.-in-C. Bomber Command, has presented a trophy in the form of a rapier for competition at No. 231 O.C.U.

Sir Hugh recently presented the trophy to the first winning crew. They were: Sgt. M. Hawkins (captain) and P/Os. V. H. Seal and M. A. Lyons (navigators).

THE FIRST LADY: P/O. Jean Lennox-Bird, W.R.A.F.V.R., is the first woman to qualify for R.A.F. wings; She has some 3,100 hours to her credit, on more than 90 aircraft types.

F/O. A. J. A. Ellwood

IT is with deep regret that *Flight* has to record the death, in a flying accident, of F/O. A. J. A. Ellwood, son of Air Marshal Sir Aubrey Ellwood. When he was practising aerobatics for the Battle of Britain "At Home" held at Carnaby, Yorkshire, last Saturday, his Meteor hit a lorry, the driver of which also lost his life. F/O. Ellwood had gained a reputation for display aerobatics, and his brilliant performance at the National Air Races at Newcastle-on-Tyne last summer will be remembered by all who saw it.

Australian Wing in Malta

AS part of Australia's contribution to the Commonwealth's Middle East defence plan, a Royal Australian Air Force unit, No. 78 Fighter Wing arrived in Malta recently for a two-year stay. Their arrival is historical, as it is the first time that an Australian air wing has been stationed abroad in peacetime; it is also the first occasion on which a complete Australian wing has served in Malta.

No. 78 Fighter Wing is commanded by W/C. Brian Eaton, D.S.O., D.F.C. The unit flies Vampires and Meteors, which are maintained by Nos. 376 Maintenance and 476 Base Squadrons.

The Australians are stationed at the naval base at Hal Far, known as H.M.S. *Falcon*. They are reported to like Malta, which they find not dissimilar from their own country. Some 50 wives are joining their husbands shortly.

R.O.C. at St. Eval

CORNWALL and Devon members of No. 20 Group, Royal Observer Corps, recently visited R.A.F. Station St. Eval for their annual outing, where they were welcomed by the Station Commander, G/C. D. M. Somerville.

The visitors flew in Shackletons, and speed and height competitions were won by Observer E. G. Tregilgas, with Ldg. Observer L. Scoble and Chief Observer R. V. Hoare as runners-up. During the evening a demonstration of high-speed aerobatics by jet aircraft was followed by a display of "how *not* to fly the Tiger Moth."

The group's efficiency trophy was presented by A.V-M. J. A. Boret (Retd.) to the Tare 4 Post.

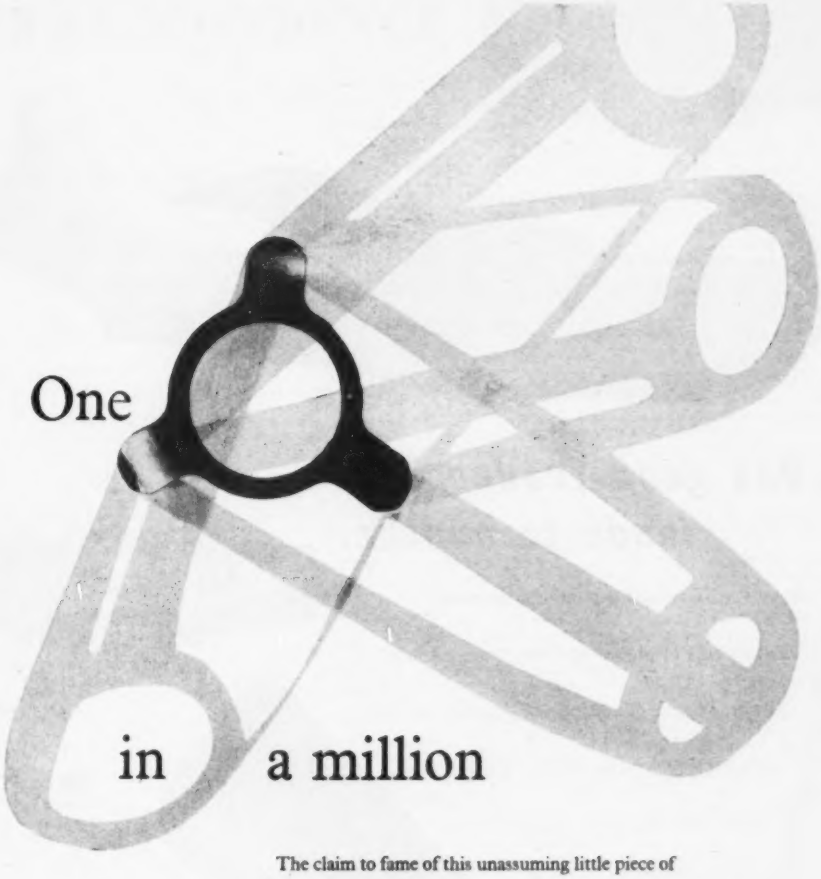
Reunions

THE third reunion of ex-members of the Fleet Air Arm and Royal Air Force who served at the U.S. Naval Air Station, Pensacola, Florida, U.S.A., is to be held in London during November. Particulars are obtainable from L. V. Armstrong, 14, Newbury Court, Hermon Hill, Wanstead, London, E.11. Wanstead 7217.

No. 150 Squadron's reunion will be held on Saturday, November 15th, at the Swiss Hotel, Old Compton Street, London, W.1. Tickets (6s 6d) from L. Hodgson, 33, The Fairway, Bickley, Kent.

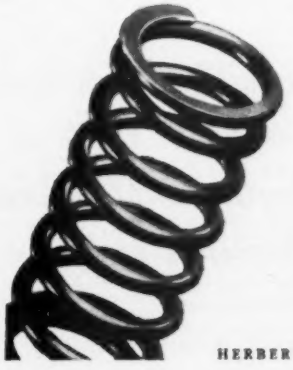
The seventh annual reunion of past and present officers of No. 42 Group will take place on Friday, October 17th, at Frascati's Restaurant, Oxford Street, London. Organization is in the hands of S/L. H. M. Hutt, 170, Upper Woodcote Road, Caversham, Reading, Berkshire.

IN NORTH MALAYA: Air Marshal A. C. Sanderson, A.O.C.-in-C. F.E.A.F. chats with P/O. Strange at Butterworth airfield. P/O. Strange has been seconded from No. 87 (PR) Squadron R.A.A.F. to an R.A.F. Mosquito P.R. squadron of F.E.A.F.



One in a million

The claim to fame of this unassuming little piece of presswork is not that it is capable of casting such curious shadows ! The thing that counts is that though just one of millions of components produced by Terry's each year, it is dead accurate to specification in every single detail. If ever you are stumped by a problem of springs or presswork, who better to advise you than Terry's, with their ninety odd years of experience in this specialised field ?



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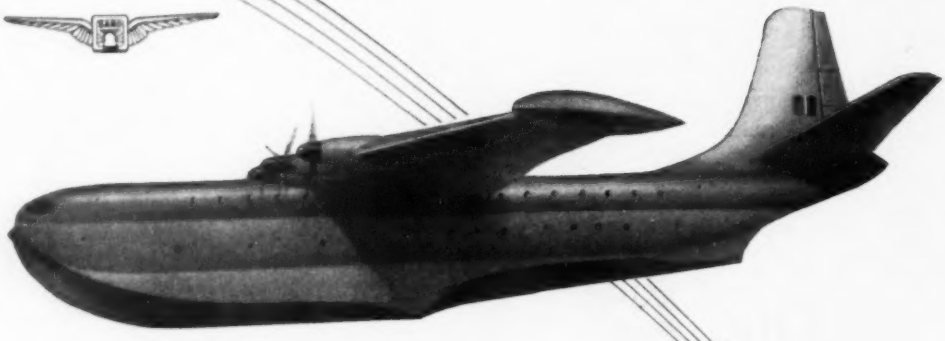
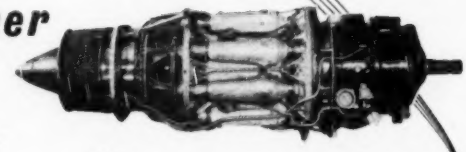


One good trademark leads to another



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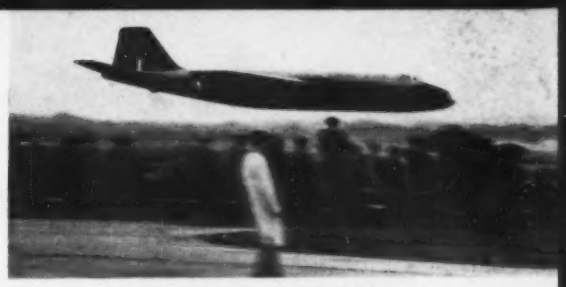


The reheat-Avon Canberra's low pass (see first letter).

Fast and Low at Farnborough

IN the September 12th issue of *Flight*, on page 353, you mention the fact that "one of Heyworth's passes was, perhaps, the lowest yet made by any jet aircraft at any Farnborough Display." The enclosed photograph shows, I believe, the "pass" to which you refer; you may wish to publish it, as one more of Bob Fairbairn's classics.

Brough, E. Yorks. M. G. K. BYRNE,
Blackburn and General Aircraft, Ltd.

[The photograph is reproduced in the heading. Bob Fairbairn is the company's official photographer—ED.]

Breaking New Ground?

THE letter from Mr. C. G. Grey in *Flight* of September 5th, concerning Mr. Claude Hunter and the construction of Portsmouth Aerodrome, is not entirely accurate in that the Hunter firm was responsible only for the drainage and surfacing. All the heavy demolition work for removing the forts and earthworks on the north and north-east sides of the site was carried out by Frank Bevis, Ltd., of Portsmouth, with whom I was employed at the time.

Relations between Bevis and Hunter sometimes became a little strained because, after some of the larger explosions, huge pieces of concrete would drop on adjacent newly "hunterized" territory.

Richmond, Surrey. L. S. WHICHER.

Airport Passenger Facilities

IS it not time that our Ministry of Civil Aviation took serious note of the deplorable standard of passenger facilities offered at British airports—and, above all, those at London Airport? We have all heard the story about temporary conditions, which somehow have a habit of dragging on for five, ten or fifteen years. Yet outside this country other nations seem able to cope so much better.

Take, for instance, the temporary buildings of Ciampino, Rome, where one can find a model airport restaurant giving prompt service throughout the 24 hours and an excellent standard of food without exorbitant charges.

Another important requirement at an international airport is an adequate washroom for travel-stained passengers; an excellent example of what this should be can be found at Geneva.

It is not enough for our British Corporations to lead the way in the air by virtue of superior aircraft and operating technique if the human needs of the passenger receive scant consideration when he lands on our shores. The Ministry of Civil Aviation has lagged behind long enough in matters of this sort, and it is high time that the leeway was made up.

London, W.1. JOHN GRIERSON.

Supersonic Bangs

WILL any of your readers please confirm or explain disagreements with my conclusion that reasoning along the lines of Döppler's theory of wave-distortion affords the best explanation of most of the sonic "barrier" phenomena (particularly the following ones)?

(a) The hearing of bangs only ahead of the aircraft.
(b) The reported sensations of aircrews experiencing passage through a compression at sonic speed.
(c) The evidence that bangs occur whenever the aircraft's speed coincides with that of sound fits entirely with this theory.

We know sound to be a band of wavelengths within the general class of air compression waves that travel with sonic speed; also that sonic speed decreases with altitude and increases in air of higher density, and that density varies from place to place in the air (with the "met"). Furthermore, that in flight an aircraft must send out complex compression waves, audible and otherwise, because its surface, particularly the frontal one, is attacking varying-density air; and all this adds up to "drag." Inaudible waves could, by Döppler effect, become audible.

Considering an aircraft increasing its speed from, say, 700 to 800 m.p.h. as it approaches a stationary observer, and the wave-chains of air compression he will experience when they reach him, one concludes that he must receive spectacular wave-distortion and therefore sound freaks.

Up to sonic speed, the wave-chains sent ahead by the frontal area will be of decreased crest-spacing that goes on reducing as the aircraft accelerates. This is a normal Döppler effect. But at sonic speed the crest spacing must become *zero*, because of the fact that, going on to supersonic speed, the aircraft must create an ever-*increasing* wave-crest spacing with its acceleration. But at this stage there is, too, the almost "Einsteinian" result that the wave-crests will reach the observer reversed in order from their order of generation. (Almost a sound turned inside out, however peculiar that may seem!)

Surely there is little wonder, then, that the observer receives a very compressed wave from the change-over point, no matter what the aircraft does thereafter, and that he hears it as a bang, because it's almost identified with a gun-muzzle sound-wave.

Furthermore, the "barrier" itself must be formidable, because it is the integrated force of work done on every individual compression that the aircraft has to deal with while it is at sonic speed. Once past sonic speed, the frontal area again encounters one buffet at a time and so seems to have got through a barrier; in fact, it is doing less work on compressed waves, i.e. the work is spread out again.

Wouldn't it be better named a "frontal compression bank," because it stops neither sound nor aircraft, and therefore is hardly a barrier to anything?

Leeds, 8. A. J. MACDONALD.

Early Hollow-steel Airscrews

MAY I venture to question your statement that the de Havilland airscrews for the Britannia are "the first production application of the hollow-steel blade in this country"? Fixed-pitch airscrews with hollow-steel blades were in service with the Royal Air Force some twenty years ago. These were of Leitner-Watts design.

I can speak only from memory, but I have a clear recollection of seeing a propeller of this pattern fitted, I believe, to a Blackburn Dart, as long ago as 1928. It may have been a year or two later than this, but cannot, I think, have been later than 1934. Your own records will no doubt enable you to check this, as these propellers received some publicity at the time of their introduction; I remember an article in your pages describing their method of construction from welded steel sheet.

Horning, Norfolk. N. YOUNG,
Wing Commander (Ret.).

[Our correspondent is correct. These hollow-steel-blade airscrews were made in considerable numbers during the 1920s by Metal Propellers, Ltd., who are still in business at Purley Way, Croydon, though no longer as airscrew manufacturers. In 1926 they made 16ft hollow-steel two-blade airscrews for the airship R.101.—ED.]

FORTHCOMING EVENTS

Sept.	27.	Society of Licensed Aircraft Engineers: "Fatigue," by Maj. P. Litherland Teed, A.R.S.M., M.I.M.M., F.R.Ae.S.
Sept.	28.	Aero-Club de France: Coupe Stemm Helicopter Competition.
Oct.	2.	R.Ae.S.: Eighth British Commonwealth and Empire Lecture: "Maintaining Airworthiness in Operation," by R. E. Hardingham, O.B.E., F.R.Ae.S.
Oct.	3.	Helicopter Association: Brains Trust (Question Master, N. E. Rowe, C.B.E., F.R.Ae.S.).
Oct.	9.	Institute of Welding (Teeside Branch): Recent Development in the Welding of Aluminium Alloys," by E. J. Heeley, A. Met., F.I.M. (at Nottingham).
Oct.	13.	Women's Engineering Society: "Meteorology and the Engineer" (lecturer to be announced).
Oct.	15.	Aircraft Recognition Society: Second 1952-3 Meeting and contests.
Oct.	16.	Institute of Welding (South London Branch): "New Ideas on the Welding of Aluminium," by P. T. Houldcroft.
Oct.	28.	Aircraft Recognition Society (Plymouth Branch): Second 1952-3 Lecture Meeting and Recognition Contests.
Nov.	7.	Helicopter Association: "Operational Future of the Helicopter," by P. G. Masefield, M.A.(Eng.), F.R.Ae.S.
Nov.	8.	British Interplanetary Society: "Evolution of Life in the Universe," by Prof. J. D. Bernal, F.R.S.
Dec.	5.	Helicopter Association: Simulation of Flight Loads, by Ground Tests," by M. J. Brennan, B.Sc., and R. Hafner.
Dec.	13.	British Interplanetary Society: "Guidance and Control of Missiles," by J. Humphries, B.Sc.(Eng.), A.M.I.Mech.E., A.F.R.Ae.S.

THE INDUSTRY

Extensible Maintenance Platform

APTLY named the "Giraffe," a device designed to give access to any part of large aircraft has recently been introduced by William Moss and Sons, Ltd., Mechanical Developments Division, North Circular Road, London, N.W.2.

There are four models, offering from 18ft to 40ft maximum working-heights. The makers claim that the "Giraffe" will carry four men to any height or radius within the scope of each particular model, and will reach that position in a few seconds.

The ram which (acting as a telescopic strut) elevates the upper flight of steps is coupled to a hydraulic pump mounted at ground level. The operator manually pumps the platform to the required height; power operation is optional. The platform is lowered when hydraulic pressure is released, but a mechanical safety-lock prevents descent until a release control is operated.

Strong guard-rails and toe-boards are provided on the platform and twin ground-jacks prevent movement of the frame. Protective buffers of canvas-covered rubber sponge are laced to the platform edges, to prevent damage to the aircraft. The "Giraffe" can be easily moved from point to point, or dismantled for shipment by air, road, or rail.

William Moss and Sons, Ltd., also manufacture the smaller "Beanstalk" hydraulic working platform, principally of use for maintenance work in and around buildings.

The Story of Fawley

A NEW documentary film, entitled *Fawley Achievement*, produced by the Esso Petroleum Co., Ltd., and shown for the first time on September 16th, portrays the construction of the Esso oil refinery at Fawley, near Southampton—which was opened in September 1951—throughout all its stages. The film will not be generally publicly shown, but copies, in 35 mm and 16 mm versions, may be obtained on loan by application to the Esso Public Relations Department, at 36, Queen Anne's Gate, London, S.W.1.

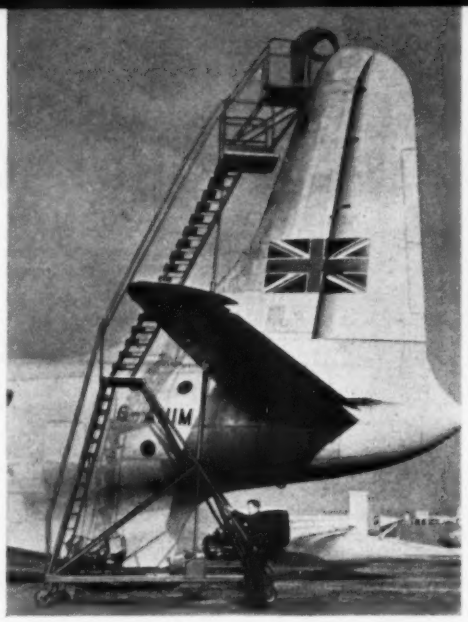
Among the products of the refinery is "premium-grade" petrol, at present being blended with lower-octane fuels to conform to Pool specifications, but which the company hopes to make generally available as soon as Government permission is obtained.

On-the-spot Technical Drawing

A PORTABLE technical drawing device, known as the "Quick-draw," has recently been introduced to assist in rapid and reasonably accurate production of plans and sketches up to a size of 10in by 13in. Intended not as a drawing-office instrument but for quick, convenient "on-the-spot" use, the device consists of a Perspex template featuring 30 deg, 45 deg, 60 deg, horizontal and vertical edges, inch and millimetre scales, a range of circles, and pencil-point holes for hatching.

The template is toggle-hinged by Perspex arms to the drawing base (which forms one half of the carrying folder), and is adjusted to obtain the appropriate ruling guide. A wide range of work can be performed without the use of other drawing instruments. The device, priced at 70s, is manufactured by the Quickdraw Company, 127, Gunnersby Avenue, London, W.3.

FOR TELLING TRUE STORIES: The latest Elliott ten-channel strain-gauge display equipment for simultaneous indication of amplitude or wave-form on a cathode-ray tube. Of portable design, for use in an aircraft or other moving vehicle, it was one of the many items of research and test equipment shown by Elliott Brothers (London), Ltd., on their stand at the S.B.A.C. Exhibition.



The "Giraffe" maintenance platform—described in the adjacent column—can be extended to a height of 40ft or set at any required angle.

Sheet-alloy Craftsmanship

A FABRICATION problem which, though it concerned a marine craft, might equally well arise in aircraft work, was successfully tackled by the Clip-On Co., Ltd., Swanwick, Southampton, in making the Ghost air intakes for John Cobb's *Crusader* (the aircraft-like structure of this vessel was described in *Flight* of September 5th).

The twin oval ducts, of light alloy, curve inboard and sweep down and aft from fairing attachments to the engine intakes. The through-section axis is a constantly changing one, yet maintains equal volume throughout the entire length of the ducts.

Divided into sections, the duct shells were hand-shaped, welded and dressed, and fitted with vertical angle rings which serve the combined purposes of butt-joining the sections, of reinforcement, and of providing a means of frame attachment; they are also supplemented by horizontal stiffeners.

The fabrication of these items necessitated the use of some 6,000 countersunk rivets of a close tolerance to achieve a clean, flush internal finish—which, together with true blending of the sections in final fabrication, ensured smooth passage for the airflow when in operation.

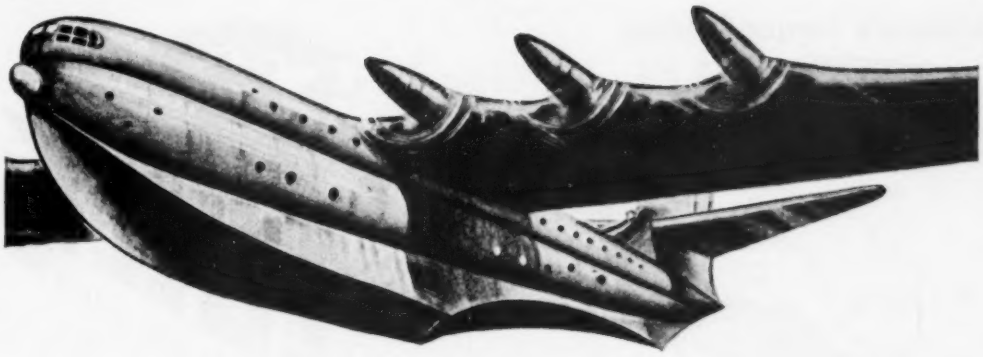
On the streamlined fairings, similarly reinforced and fabricated, the intake mouths are welded integral with the entry sections of the ducts, whilst the main body is readily detachable to provide accessibility to the interior.

Gas-turbine Courses

FROM Power Jets (Research and Development), Ltd., come details of their programme of gas-turbine short courses to be given at the School of Gas Turbine Technology, Farnborough Place, Hants, for the session 1952-53:—

Course No. 55, Practical Aero Engine Course, Oct. 6th-17th; No. 56, Design and Applications of Industrial Gas Turbines, Oct. 27th-Nov. 14th; No. 57, Aero Engine Design, Nov. 24th-Dec. 12th; No. 58, Design and Applications of Industrial Gas Turbines, Jan. 5th-23rd; No. 59, Aero Engine Design, Feb. 2nd-20th; No. 60, Practical Aero Engine Course, Feb. 23rd-Mar. 6th; No. 61, Design and Applications of Industrial Gas Turbines, Mar. 16th-Apr. 2nd; No. 62, Aero Engine Design, Apr. 13th-May 1st; No. 63, International Course on Aero and Industrial Gas Turbines, May 4th-22nd; No. 64, Theory and Design of Compressors, June 8th-12th; No. 65, Theory and Design of Turbines, June 15th-19th; No. 66, Combustion and Heat Exchangers, June 22nd-26th.

The design courses are of approximately post-graduate standard, and are open to British and Commonwealth students. The international courses, of similar standard, are for overseas students only, and the practical courses, not requiring a high academic standard, are open to students of all nationalities. All courses start at 9 a.m. on a Monday and finish on the following Friday afternoon.



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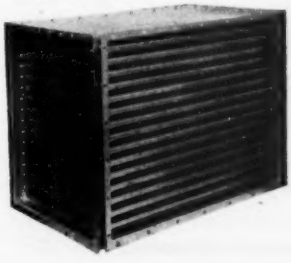
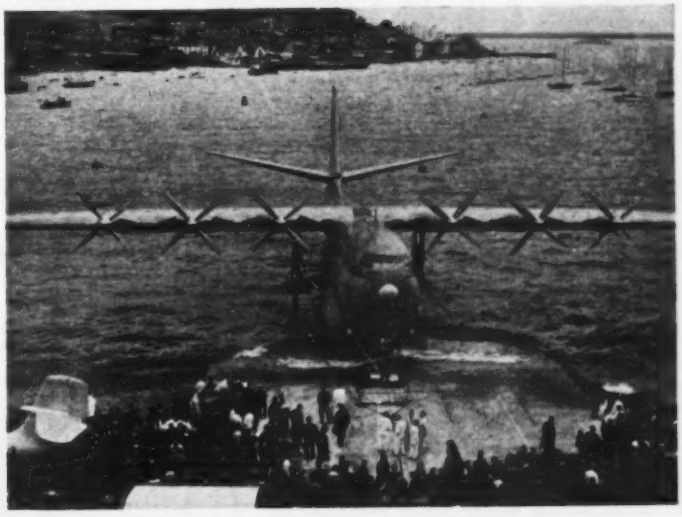
'Marex' heater unit.





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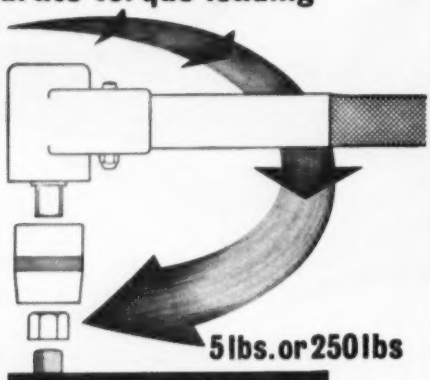

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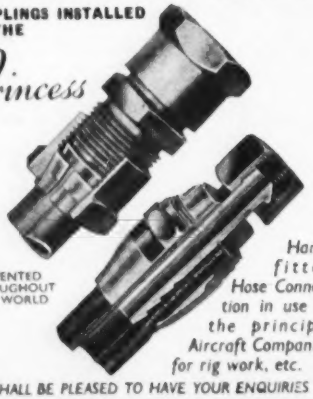

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 17. From Starways, Ltd., of Speke Airport, Liverpool, for a seasonal Inclusive Tour air service with Dakota aircraft for the carriage of passengers between Liverpool (Speke) and Tarbes (Lourdes) at a frequency of from 5 to 10 services weekly during the period from May 1st, 1953, to October 31st, 1957.

FROM Starways Air Transport, Ltd., of 55, Pall Mall, London, S.W.1:

Application No. 18: for a Colonial coach service initially with Viking (VC1) aircraft for the carriage of passengers, supplementary freight and mail between London (Bovingdon) and Salisbury, S. Rhodesia, with intermediate traffic stops at Nice, Malta, Wadi Halfa, Khartoum, Juba, Entebbe, Tabara, N'Dola and Lusaka at a frequency from one service fortnightly to one service weekly for a period of seven years from the date of approval.

Application No. 19: for a Colonial coach service initially with Viking (VC1) aircraft for the carriage of passengers, supplementary freight and mail between London (Bovingdon) and Malta at a frequency of three services weekly for a period of seven years from the date of approval.

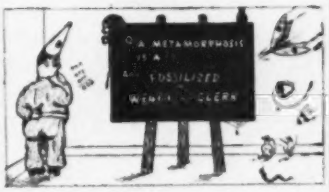
Application No. 20: for a Colonial coach service initially with Viking (VC1) aircraft for the carriage of passengers, supplementary freight and mail between London (Bovingdon) and Accra with intermediate traffic stops at Bathurst and Freetown, at a frequency of one service fortnightly to one service weekly for a period of seven years from the date of approval.

FROM Cambrian Air Services, Ltd., of Cardiff Airport, Cardiff:

Application No. 21: for an internal service with DH.89 aircraft and DH. Dove aircraft for the carriage of passengers and supplementary freight between Liverpool (Speke) and Jersey (C.I.), with intermediate traffic stops at Cardiff and/or Bristol, Southampton (demand stop) and Guernsey (demand stop), supplemented by direct flights to Jersey from Liverpool, Cardiff and Bristol, at a frequency of from 3 to 54 services weekly in the Channel Islands during the period from May 2nd, 1953, to May 1st, 1963.

Application No. 22: for an internal service with DH.89 and DH. Dove aircraft for the carriage of passengers and supplementary freight between Manchester (Ringway) and Jersey (C.I.), with intermediate traffic stops at Bristol and/or Cardiff and Guernsey (demand stop), at an initial frequency of twice weekly in the winter months only during the period from October 2nd, 1953, to October 1st, 1963.

(continued in Col. 3)



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PUBLIC ANNOUNCEMENTS

(continued from Col. 1)

Application No. 23: for an internal service with DH.89 and DH. Dove aircraft for the carriage of passengers and supplementary freight between London (Northolt) and Haverfordwest (Withybush), with intermediate traffic stops at Swansea, Cardiff and/or Bristol, at a frequency of two to three services weekly during the period from May 1st, 1954, to April 30th, 1964.

Application No. 24: for an internal service initially with DH.89 and DH. Dove aircraft for the carriage of passengers and supplementary freight between London (Northolt) and Land's End (St. Just), with intermediate traffic stops at Bristol and/or Cardiff, at a frequency of two to three services weekly during the period from May 1st, 1954, to April 30th, 1964.

Application No. 25: for an internal service with DH.89 aircraft for the carriage of passengers and supplementary freight between Cardiff Airport and Weston-super-Mare at a frequency of six services weekly and on demand during the period from April 1st, 1953, to March 31st, 1960.

Application No. 26: for an internal service with DH.89 aircraft for the carriage of passengers and supplementary freight and mail between Land's End (St. Just) and Scilly Isles (St. Mary's) at a frequency of 12 services weekly, increasing in accordance with demand, during the period from April 1st, 1953, to March 31st, 1963.

Application No. 27: for a normal scheduled service with DH. Dove aircraft for the carriage of passengers and supplementary freight between Cardiff Airport and Paris (Le Bourget), with possible intermediate traffic stops at Bristol and/or Southampton, at an initial frequency of two services weekly (winter) and three services (summer) during the period from April 1st, 1953, to March 31st, 1963.

Application No. 28: for a normal scheduled seasonal service with DH. Dove aircraft for the carriage of passengers and supplementary freight between Cardiff Airport and Dinard at a frequency of one service weekly, increasing with demand, during the period from May 2nd, 1953, to March 31st, 1963.

FROM Air Kruise, Ltd., Lympne Airport, Kent:—

Application No. 29: for a normal scheduled seasonal service initially with DH.89A aircraft for the carriage of passengers and supplementary freight between Lympne, Ramsgate and Ostend at a frequency of 6 to 14 services weekly during the period from April 1st, 1953, to March 31st, 1963.

Application No. 30: for a normal scheduled seasonal service with DH.89A aircraft for the carriage of passengers and supplementary freight between Ramsgate and Le Touquet, with an intermediate traffic stop at Lympne, at a frequency of 4 to 14 services weekly during the period from April 1st, 1953, to March 31st, 1963.

FROM Airwork, Ltd., 15, Chesterfield Street, London W.1:

Application No. 31: for an all-freight service initially with Avro York and Avro Tudor aircraft for the carriage of freight between London Airport and Montreal (Dorval), with intermediate traffic stops at Shannon and Gander, at an initial frequency of two services weekly during the period from June 1st, 1953, to May 31st, 1955.

Application No. 32: for an all-freight service initially with Avro York and Avro Tudor aircraft for the carriage of freight between London Airport and New York (Idlewild), with intermediate traffic stops at Shannon and Gander, at an initial frequency of two services weekly during the period from June 1st, 1953, to May 31st, 1963.

Application No. 33: from East Anglian Flying Services, Ltd., of Southend Airport, Southend-on-Sea, Essex, for a normal scheduled service with DH.89A aircraft for the carriage of passengers, supplementary freight and mail between Brighton (Shoreham) and Dieppe at a frequency of 7 to 28 services weekly during the period from April 1st, 1953, to March 31st, 1960.

FROM B.K.S. Aerocharter, Ltd., of Dorset House, Old Burlington Street, London, W.1:—

Application No. 34: for an internal service, initially seasonal, with Dakota aircraft for the carriage of passengers, supplementary freight and mail between Newcastle (Woolsington) and/or West Hartlepool (Greatham) and London (Northolt) at a frequency of from 3 to 12 services weekly during the period from January 1st, 1953, to December 31st, 1959.

Application No. 35: for an internal service, initially seasonal, with Dakota aircraft for the carriage of passengers and mail between Newcastle (Woolsington) and/or West Hartlepool (Greatham) and Jersey at a frequency of from two to nine services weekly during the period from January 1st, 1953, to December 31st, 1959.

Application No. 36: for an internal service, initially seasonal, with Dakota aircraft for the carriage of passengers and mail between Newcastle (Woolsington) and/or West Hartlepool (Greatham) and Ronaldsway (I.O.M.) at a frequency of from one to four services weekly during the period from January 1st, 1953, to December 31st, 1959.

Application No. 37: for an Inclusive Tour air service, initially seasonal, with Dakota aircraft for the carriage of passengers between Newcastle (Woolsington) and Paris (Le Bourget) at a frequency of one service weekly during the period from January 1st, 1953, to December 31st, 1959.

Application No. 38: for an Inclusive Tour air service, initially seasonal, with Dakota aircraft for the carriage of passengers between Newcastle (Woolsington) and Basle at an initial frequency of eight services each summer during the period from January 1st, 1953, to December 31st, 1959.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing, stating the reasons, and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 9, Buckingham Gate, London, S.W.1, from whom further details of the applications may be obtained. [0701

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The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

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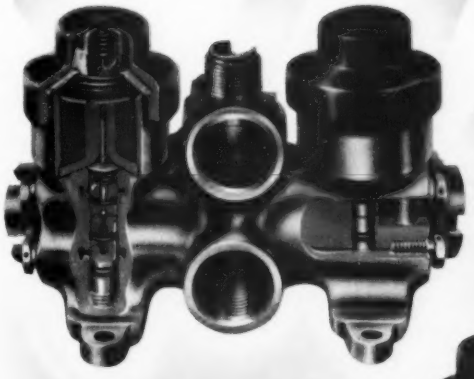

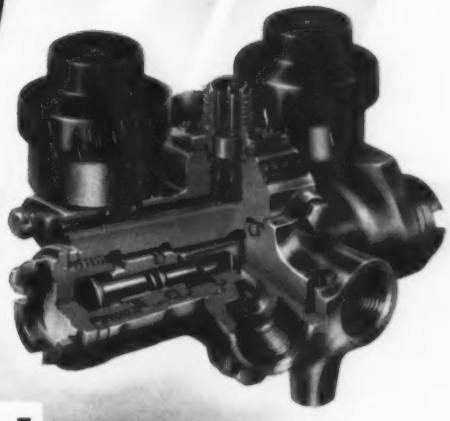

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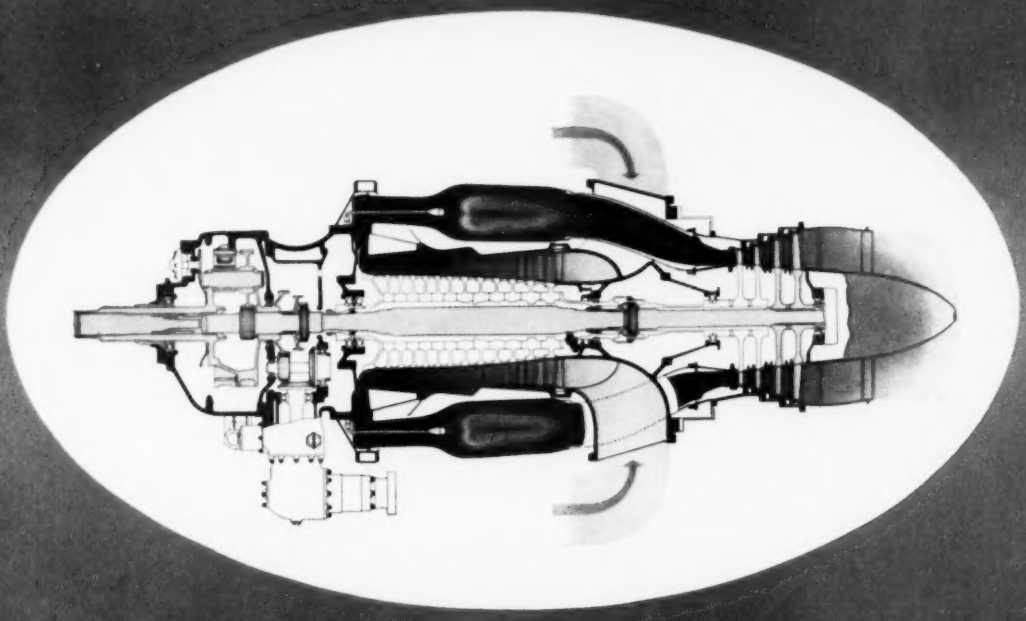

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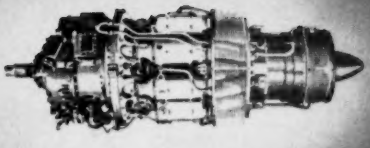

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